EXCHANGE ROOM
JANUARY 1907
JUNE 1907

AMERICAN MEDICAL ASSOCIATION

AMERICAN QUARTERLY OF ROENTGENOLOGY

PUBLISHED BY THE AMERICAN ROENTGEN RAY SOCIETY

Volume I. No. 2

Next Annual Meeting
Cincinnati

September 25th, 26th
and 27th, 1907.

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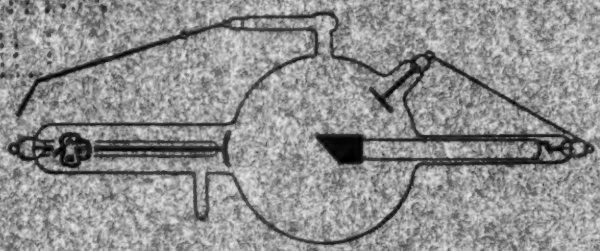

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APPLICATION FOR MEMBERSHIP
IN
THE AMERICAN ROENTGEN RAY SOCIETY

I, _____, hereby make application for membership in
THE AMERICAN ROETGEN RAY SOCIETY

I am _____ of age. I was born at _____ and now reside at _____
_____ I am a graduate of _____
from which I hold the following degrees; _____
_____
My occupation at present is that of _____
I am now a member in good standing of the following learned societies:
_____
_____

Signature _____

We, members in good standing of THE AMERICAN ROENTGEN RAY SOCIETY, consider
_____ to be well qualified to become a good and useful member of the Society,
and recommend that _____ be received.

Signature _____

Signature _____

The Executive Committee hereby approves the above application.

Signature _____

Signature _____

Signature _____

EDITORIAL DEPARTMENT

THE ROENTGENOLOGIST AND THE GENERAL PRACTITIONER.

Roentgen diagnosis and Roentgen therapy have proved their value. The demand for expert knowledge and special experience in those who employ this method is an evidence that the general practitioner appreciates their value to his patient. Roentgenology as a special branch of medical science is the result of an increase in knowledge and the demand for its accurate and scientific employment. This demand for special skill is one of the acknowledgments of the value to the general practitioner of this method of diagnosis and therapy. Roentgenologists are admittedly the possessors of special knowledge and technic that is valuable to practitioner and patient but this admitted position carries with it responsibilities and duties to the practitioner and patient. The Roentgenologist is responsible to the medical world for the ethical employment of this agent, for conservative estimates in its study and adaptation to medicine, and for accurate information and demonstration of its value and its field of application by unquestionably better results.

It is the duty of the Roentgenologist to inform the general medical profession on these points, to demonstrate its progress; to show them where and how it can be of value to their patients; to warn them of the dangers in ignorant employments and to decry the exaggerated and baseless claims of charlatans and quacks.

It is the duty of the Roentgenologist to increase the knowledge of the medical profession in regard to the assistance which this method can render them in diagnosis and where better and more certain results can be obtained by its employment.

The burden of proof lies with the Roentgenologist. He should not say what he can do only, but demonstrate what he has done. Conservatism should mark his relations to the general profession. They can not be made to appreciate its value except by the demonstration of results better than those obtained by other methods. These results are accomplished, they must be repeatedly demonstrated. The Roentgenologist has a duty as an educator of the medical profession. He must keep his fellow practitioners conversant with the progress that has been made

and is making constantly in his special line of work. This can only be done by association with his fellow practitioners in local, state and national meetings. These meetings are for the dissemination of useful knowledge, and he should contribute his share in the interchange of thought. He has much that is valuable to demonstrate—results that prove the value to diagnosis, that show an advance in the treatment of disease, that mark steps in the progress of scientific knowledge. It is his duty to the profession to attend the meetings of the general medical public and by papers, demonstrations and open discussion help them to appreciate and realize the value of this more accurate method of diagnosis and most potent agent in therapy.

C. L. L.

At the coming annual meeting in Cincinnati there will be a symposium on "Protection to the Operator." In the general discussion there will be afforded opportunities for the members to demonstrate with lantern slides the arrangements which they personally have found adequate and convenient. That this feature of the meeting may be productive of the greatest good, the executive committee would urge the members to prepare slides as the opportunity presents itself, so that they may be available when needed.

THE PRINT EXHIBIT AT CINCINNATI.

The interest in last year's print exhibit was so great that the committee feels that this feature of the annual meeting should be continued.

In order to insure the success of this undertaking and make it of value it has been decided to ask each member to furnish two negatives of each of the following subjects:

Osteo-sarcoma.

Tuberculosis of joints.

Renal calculi.

These negatives are to be of uniform size, 8x10 inches, and arrangements will be made for displaying them by means of permanent frames, arranged on the plan of illuminating boxes. The negatives will be permanently mounted with the films turned in and cannot suffer the slightest injury and no one need be deterred from exhibiting his choice negatives of the above named conditions.

In this way we hope to bring out a collection of negatives showing every possible manifestation of these conditions and which will be of practical benefit to every mem-

ber attending. Members that are not certain of attending the meeting may send plates to any member of the print committee and they will be returned promptly.

H. W. DACHTLER, *Chairman*,
237 Michigan St., Toledo, O.
PERCY BROWN, M. D., 155 Newberry St., Boston, Mass.
SIDNEY LANGE, M. D., Cincinnati Hospital, Cincinnati, O.

We would like to call attention of our members to the announcement of the print committee. The members having this exhibit in charge have decided to make the work displayed this year have a distinct educational value. This will be secured by having arrangements for the demonstration of a limited number of plates illustrating the subjects selected by the committee. It will enhance the value of this work and facilitate the labors of those in charge if exhibitors will make their selections early and communicate with the chairman as requested. If there is the active cooperation of a large number of the members, the exhibit will be a great feature of our next convention.

Now that the officers have decided when and where the next convention is to be held it behooves members to make plans to be present during all the sessions. While the program is not quite ready for publication, there is every evidence that a very instructive and interesting class of papers will be presented.

While this society has a large and active membership, there are many good workers to whom the society would be of great benefit and whose presence at our meeting would be of value. It would seem that each active member could secure one new desirable member. It would add greatly to the effectiveness of our society if it included all the representative workers in Roentgenology in America.

It has been suggested that there be formed three sections in our Association: An eastern, a middle section and a western. These sections could have a one day session so as to break the long gap between the annual meetings. This plan has been tried in some of the national societies of special workers and found to be very effective in promoting society interest. Now that we have our own official organ, the announcements of the meetings could be very easily arranged. This division into sections might be discussed at our meeting in Cincinnati. P. M. H.

THE AMERICAN ROENTGEN RAY SOCIETY AND THE AMERICAN MEDICAL ASSOCIATION MEETING AT ATLANTIC CITY, JUNE, 4-7, 1907.

The Philadelphia Roentgen Society has arranged for an exhibit of Roentgen negatives as a part of the Scientific Exhibit of the American Medical Association at Atlantic City.

The purpose of the exhibit is to demonstrate the scope and value of the Roentgen method of diagnosis. The exhibit will be made in the name of the American Roentgen Ray Society and plates will not be grouped under individual names of Roentgenologists or institutions.

The illuminated negatives will be grouped according to pathologic lesions and in anatomical sequence, with the diagnosis and name of Roentgenologist attached to each plate.

The Committee on Scientific Exhibit of the American Medical Association has reserved a limited space for the exhibit. The number of plates accepted from any individual must necessarily vary with the subject, the quality of the negative, their importance in completing a series and the total number offered. None but negatives of the clearest definition should be sent, as they must be appreciated by persons less experienced in reading them.

Kindly send a list of plates with subjects and size which you are willing to send for the exhibition to the Committee, and thus aid them in collecting a comprehensive, representative and educational exhibit. Good illustrations of fractures, dislocations and foreign bodies are wanted, more particularly rare cases, though the more common are of very practical importance. Lists of negatives should be sent immediately to the Chairman of the Committee, who will also furnish any information in reference to the meeting at his command.

For the Committee:

WILLIAM S. NEWCOMET,
THOMAS S. STEWART,
CHARLES LESTER LEONARD,
Chairman.

112 South Twentieth St., Philadelphia.

AMERICAN

Quarterly of Roentgenology

Volume I JANUARY, 1907 Number 2

FURTHER OBSERVATIONS ON THE ROENTGENOLOGY OF THE STOMACH AND INTESTINES.

PRESIDENT'S ADDRESS.

Henry Hulst, A. M., M. D., Grand Rapids, Mich.

DELIVERED AT THE SEVENTH ANNUAL MEETING OF THE AMERICAN ROENTGEN RAY SOCIETY, NIAGARA FALLS, N Y., AUGUST THIRTIETH, 1906.

I little thought a year ago, when I had the pleasure of addressing you on Diseases of the Stomach and Intestines, that within so short a period of time I should to any extent worth recording find cause to change the technique and modify the views I then presented.

In grateful recognition of the work done by Professor H. Rieder of Munich I hailed his Roentgenographic Bismuth Method of examining the stomach and intestines as epoch making in medicine and as opening up to us a new and rich field in Roentgenography. To be able to determine with considerable accuracy the shape, size, and relative position of the stomach and colon, difficult, if not impossible by the methods of physical examination hitherto employed, deserved vastly more strenuousness than even the laborious Roentgenographic procedure required. For no gastro-enterologist, I dare say, ever looked for the first time at good Roentgenographs of these organs without being profoundly impressed by their diagnostic value, if not positively shocked by the striking inadequacy of the older methods which the pictures serve to reveal.

Two factors, a process of reasoning and an event combined to bring about my change of technique referred to. The reasoning was little more than drawing a logical conclusion to the premises laid down in my paper read in Baltimore. "For though in Roentgenography of early Phthisis intensifying screens are to be avoided because their use may defeat the very purpose of this work (the recognition of minute lung changes) the same objection can not hold equally in Roentgenography of the stomach and colon, in which we require detail less and contrast more."

If we can dispense with minute detail such as is only furnished by the photographic process without the use of intensifying screens, there is no inherent reason against, and there are many well recognized reasons for, the use of the fluorescing screen. An event gave the final impulse to the change. It was the publication of Holzknecht's "Mitteilungen." The author's first sentence unfortunately betrays a bias, and compels us to disagree; "Whithersoever we direct our gaze in radiological diagnostic we recognize a tendency to displace radiography by radioscopy." If his gaze had extended across the Atlantic he would have recognized nothing of the kind. On the contrary, American Roentgenology is steadily tending in the opposite direction. In spite of this prejudice—for aught I know because of it—and notwithstanding that Holzknecht gives scant credit to Rieder, to whom he is indebted for the impulse at least to his own work, he deserves our warmest gratitude for having initiated the second great step forward in the development of the new Roentgenology of the alimentary tract.

This is the way I now go about it. The navel is marked by a dime stuck on with adhesive plaster and the patient is stood up in a stall-like apparatus (shown upon the screen), between the properly adjusted movable arms of an orthodiagraph. In one of the hospitals I accomplish similar results by having the tube suspended in a box by means of weight, pulleys, fishline, and plummet in such a manner that when the tube is raised or lowered by the plumb-line the point of the plummet is always directly in line with the focus on the anticathode. This latter arrangement is very simple and inexpensive, and is usable to good advantage with a backrest for the patient and either a screen or a fluoroscope. The tube in this arrangement having vertical range of motion only, the patient himself must be moved sidewise to get ortho-

diascopic readings laterally, but it is very serviceable to examine in the upright position. No matter what device is adopted to secure orthodiascopy, the searching screen or fluoroscope should be lined with lead glass. The stall has sliding lead covered panels easily worked by ropes and pulleys to add to the protection afforded by the lead glass in the large searching screen of the orthodiagraph. Composition-gloves and apron and large lead glass spectacles add materially to the safety of the operator. Orthodiascopy without adequate protection is a foolish return to the dangers of the unsuspecting use of the fluoroscope in days gone by.

The room must be darkened completely, the eyes prepared for the work by remaining in the dark as long as possible, the tube and the valve tubes are covered with opaque jackets, except when using the plummetgraph and box, which hides the tube behind a roller curtain. The tube must be a fine one, must stand up well without getting soft and be thoroughly diaphragmed. It is impossible to do good work without the aid of diaphrams. This is universally recognized in Roentgenography but applies to fluoroscopy just as well.

Every requirement having been met, the next step depends upon the special purpose of the examination to be made. If this be with reference to gastroptosis and merely to ascertain what the ordinary methods of diagnosis seek to establish, half an ounce of bismuth subnitrate C. P. may be given in half a pint of water. A glance enables us to mark upon the patient's body the lowest point of the greater curvature, another to mark the lesser. Percussion of the gas distended or air inflated stomach in the prone position though generally practiced, is worse than useless as I hope to show. The only reasonable employment of this method is with the patient in the erect position, after the manner of Piorry-Penzoldt or Dehio. But as Dr. Richard Smith points out, "It is difficult to get readings in the standing position." By the orthodiascopic method, on the other hand we have succeeded in doing easily and accurately what was possible hitherto only with difficulty, "in a general way and roughly," and that moreover in less time than it takes to tell it. In this way large numbers of people may be examined with very little trouble, as for instance at recruiting stations and hospitals, and the necessary data obtained to settle for good the long standing question whether the vertical or oblique stomach is statistically

more common in men, women and children, and also whether the common and the normal are the same as applied to this organ.

The above procedure, so far from exhausting the method, is but one—one of the simplest moreover of many possible ways of using the method. Indeed it is capable of as many variations as there may be purposes for applying it. To follow out Holzknecht's unabridged scheme takes according to his own experience from 1½ to 2 hours, and this includes only the more important steps, by no means all that are conceivable. As in examining urine for albumen we do not go through the entire scheme for working unknowns, and as we do not start into motion all the mach inery of our entire diagnostic workshop irrespective of what the case may look like, so also we should not adopt and slavishly follow any stereotyped process for applying bismuth orthodiascopy to all abdominal cases alike.

The following general procedure, modifiable according to the conditions, expierience proves to be easy to carry out, not over elaborate, and exhausting to the patient, yet capable of bringing out a surprising number of important points in addition to those obtainable by the photographic method alone.

The patient is prepared as before and posed in the box of plummet graph or fixed firmly between the arms of the orthodiagraph. The stomach should be empty. In case of doubt, it should be washed out first. A seidlitz powder prepared by dissolving separately the contents of the blue and the white powder each in a half glass of water and is given to the patient in the order of soda first, and acid last. The reversed order of administering it may interfere with the rest of the examination by causing intense pain if the stomach happens to be ulcerated or hypersensitive. The tube, previously tested to read W. 5 or W. 6, is not started into action until now, and is never permitted to run uselessly. While marking orthodiagraphically the right and left diaphragm after ordinary expiration the space below the apex of the heart is seen to light up and to assume the familiar appearance encountered in fluoroscopy of the chest. Sometimes it resembles a pale moon rising out of the water, the water swallowed forming a straight line which shows ripples when the patient moves or is shaken, or, no water being visible, it may look like the moon breaking through a cloud. The spleen and even the kidney, may grow visible. After a little the light area ceases to grow. Its upper

limit bounded by a portion of the diaphragm, is marked as well as the lower. Percussion confirms the indication by the screen. By comparing the position of the diaphragm before and after the use of the seidlitz powder, we ascertain the extent of the displacement upwards of the fundus thus produced.

While the light area is fading and contracting, but before the magenblase (the collection of gas in the fundus) has time to vanish we proceed to our next step.

The patient facing us is turned 45 degrees to the left, and made to swallow a capsule or bolus of 25 gr. of bismuth subnitrate. If he finds it too large to swallow, several smaller ones may be given instead. It is interesting to watch them as they glide down the œsophagus, or become arrested, as they often do. Two or three respirations or a little water suffice to start them on again, unless arrested by a stricture or sidetracked into a diverticulum. From a little to the left of the median line of the body they come down obliquely across the light area, representing the magenblase to seek a point upon its lower border.

The patient is now turned so as to face forward once more. With each inspiration the magenblaze is seen to become narrower and to lengthen downward. The capsules moving up and down with it might easily be taken to indicate the lower border of the stomach, all the more readily because they show no disposition to leave their place. A deep inspiration promptly disillusions us. As the diaphragm descends the blase pushes downward a glove-finger-like process, carrying the capsules with it, and as the blase ascends in expiration, the process shortens, thus leaving the capsules to sink lower down slowly.

Even now they may become arrested. By pressing against the abdomen we can make them go down, however, until they can go no further. We have found the lowest point of the greater curvature of the empty stomach, and mark it upon the skin. Permit me in this connection to show you by means of these illuminating boxes, two plates I showed you a year ago, as a sort of curiosity. They are of particular interest now as Roentgenographic illustrations of the process just described as studied on the screen.

Under the dome of the left diaphragm the spleen is visible, and to the right of it and shaped by it, the magenblase. On the bottom of the blase, where its finger-like

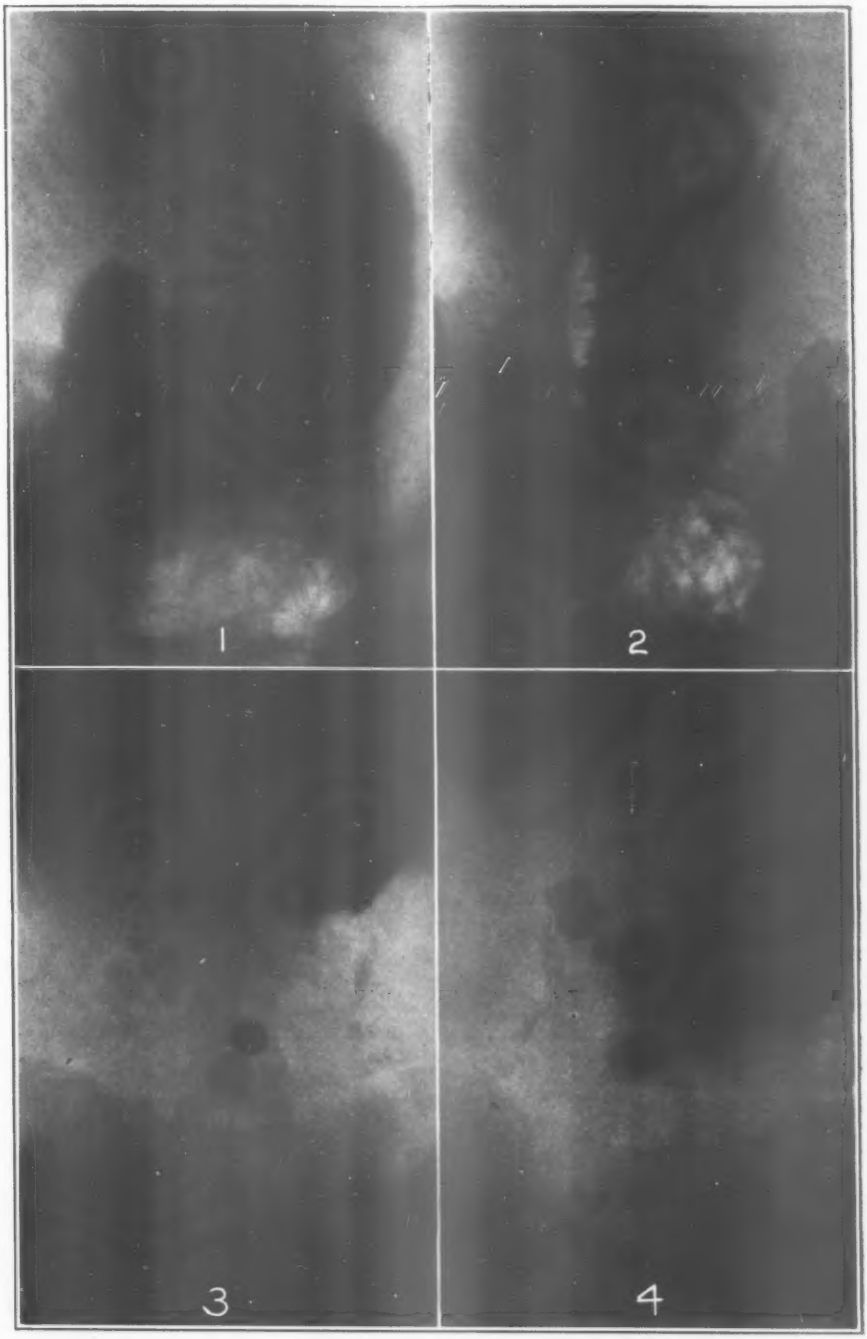
process forms during inspiration as described, two capsules with bismuth have become arrested in their downward course. Two inches lower is a group of seven capsules marking, no doubt, the caudal pole of this comparatively normal stomach.

No. 2. Taken about five minutes later, shows the upper two capsules still on their false bottom. Their relation to each other has changed a trifle. One of the capsules in the lower group has permitted part of its contents to escape.

The patient, standing as before, next drinks slowly, with constant stirring, three drachms of bismuth subnitrate in three ounces of water. After each swallow of the liquid, a black streak is seen running downward, outward to the left, then inward to the right, to a spot a little beyond the capsules, whose track it follows closely. By this means Holzknecht diagnosed an hour-glass stomach. Permit me to show you a plate to illustrate the necessity of proceeding cautiously to avoid being deceived by mere appearances.

This stomach has the blase above separated from the bismuth containing pyloric portion below by a firmly contracted middle portion, or corpus. Massage, or more bismuth, would have unfolded the corpus, for other plates of this stomach proved it to be quite normal in this respect. In another case Holzknecht found evidence of a cancerous deposit in the walls of the stomach when no tumor was palpable. The bismuth mixture instead of following the ordinary course described, spread out irregularly over the inner surface of the stomach and persistently avoided certain areas, which on post-mortem examination were found to correspond in general contour and location with nodulous deposits of the malignant growth. Although I have not yet been able to observe this condition myself, I am convinced of the diagnostic possibilities of this procedure, in all cases of suspected non-palpable as well as of palpable growths, in the stomach. Some of the pictures I shall have occasion to show later reveal the rugae of the fundus where there is but little bismuth. It is at this stage of the examination, therefore, while the stomach is not so full as to obliterate all details of its walls, that we should look for their structural alterations.

Thus far the patient has not left his place. He will now welcome the change to lie down on the examining table while he finishes the *piece de resistance* of the bis-



To Illustrate the Presidents Address

muth meal, an ounce of the subnitrate in one pint of milk. In the horizontal position, gravity permitting the deposit of the opaque substance in the upper two-thirds of the stomach, we take its outline before we let him up again for the final examination, which will be in the erect position. By turning the patient, placed horizontally, around the long axis of his body and examining him from both sides and above and below, we can fairly see all around his stomach. For the dorso-ventral view, the patient being on his back, the orthodiagraph may be adjusted for use in the horizontal position and utilized with the tube below. For examining the patient lying on the right side or the left, the apparatus is unsuitable, and we allow for the distortion incident to focusing the target perpendicularly to the dime fixed upon the back opposite to the one fixed upon the navel. The bilateral view is best obtained in the standing position, though it may be tried with the patient on his belly.

Horizontal dorso-ventral fluoroscopy face downward requires that the observer be on his back beneath the table, which is neither graceful nor pleasant, and as this position of the patient is precisely the easiest one for obtaining a brilliant negative it is sensible to make a virtue of necessity and take a picture instead.

In order to avoid the risk of tiring you by mere descriptions of what the observer may see on the fluorescing screen when examining the patient in these various positions, and yet present a clear though partial idea of it, I will show some negatives taken partly for this purpose.

Horizontal dorso-ventral view of stomach immediately after lavage and introduction through the tube of two ounces of bismuth subnitrate in one pint of milk. Tube left in. Patient permitted to breathe during exposure of 15 sec. on account of her feeble condition. Tube enters cardia at left edge of spine and crosses the fundus obliquely downward to the left until arrested at the greater curvature. Caudal pole one handbreadth below navel. Lowest point of lesser curvature opposite fifth lumbar vertebra. When standing caudal pole was behind symphysis pubis. (No. 1.)

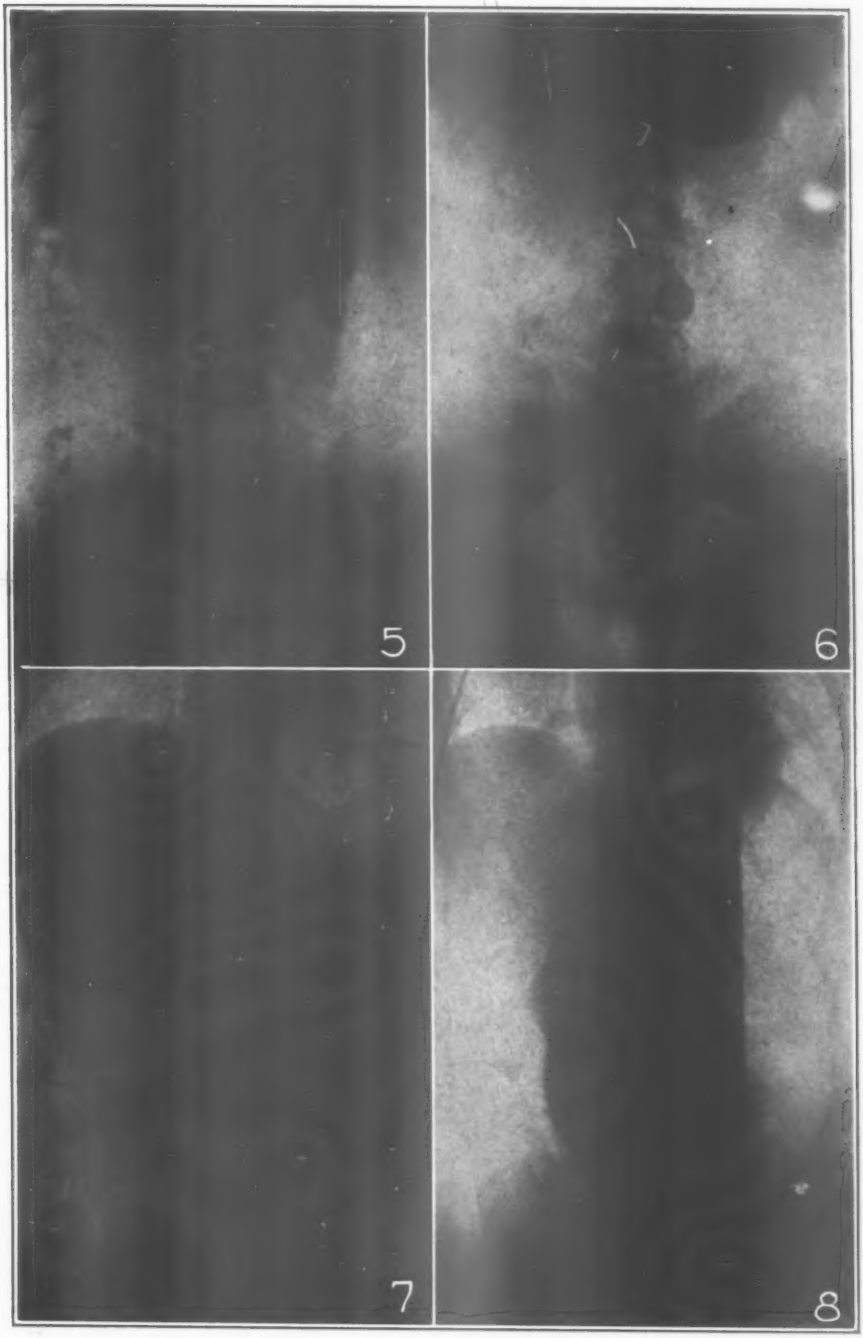
Dorso-ventral view of the preceeding stomach with the patient on the right side, taken directly after No. 1. Gravity has carried the tube across the spine so that it enters the cardia at the right edge of the spine instead of at the left as in No. 1. Most of the bismuth has

gravitated into the pyloric end, which is well distended, and presents at its upper part an irregularly indented outline.

Dorso-ventral view, patient on the right side. Immediately after lavage and introduction through tube of 3 drachms of bismuth subnitrate in 8 ounces of water the day before negatives No. 1 and 2 were taken. The tube enters cardia at the *right* edge of the spine, crosses the fundus obliquely downward to the left and turns sharply upward at the greater curvature. The pyloric end is filled with the mixture, the bismuth below and the upper level of the fluid indicated by a straight line. Corpus and fundus are filled with gas. Passing the tube into the stomach it had been noticed that it did not go down as it should. Partial withdrawal and reinsertion of it gave the same feeling of resistance. The day before orthodiascopy had revealed a magenblase which permitted a small bismuth and water mixture to settle upon its bottom without the latter showing much disposition to let it pass through in spite of prolonged and repeated pressure upon the abdomen and counterpressure against the back. Deep breathing finally causes some of it to escape through a finger-like process into the depths of the belly below. (No. 2.)

The history of the case, together with existing signs and symptoms, admitting no doubt of the presence of a non-palpable cancer which involved the stomach, the bismuth mixture persistently refusing to pass beyond the blase and the tube meeting with a decided obstruction after it had entered the stomach, the diagnosis of hour-glass malignant contraction would have seemed reasonable had not the further examination by means of the full bismuth meal as illustrated by these negatives disproved this theory and explained the misleading data, while at the same time it pointed to the pylorus as the cause of the enormous dilation and the seat of the growth. Gastro-enterostomy, followed next day by a post-mortem examination, proved the entire correctness of this view, and emphasized the importance of not mistaking the bottom of the blase for an organic stricture.

Patient a young man, on right side. Dorso-ventral exposure. Gas occupies upper (left) part, bismuth the lower (right or pyloric) end. Notice spleen and left kidney, whose upper border was palpable. Right diaphragm considerably higher than left.



To Illustrate the Presidents Address

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Same patient on his belly. Presence of some food prevents the bismuth from reaching quite to the bottom of the stomach. Lowest point of lesser curvature opposite second lumbar vertebra. The orthodiagraph showed the lowest point of greater curvature one handbreadth below the navel. (No. 3.)

Same patient on his back. Ventro-dorsal exposure. The fundus being lowered in this position, gravity serves to fill it out with bismuth.

A girl, chlorotic, aet. 13, on her belly. Dorso-ventral exposure. Notice the sphincter of the antrum, the antrum itself filled with bismuth, with the pylorus and a part of the duodenum below. Caudal pole above the navel. Orthodiagraphy, the patient standing, located caudal pole three finger-breadths below the navel. (No. 4.)

Same patient on her back. Dorso-ventral exposure. Fundus better filled with bismuth than with patient on her belly. Part of duodenum clearly shown. Notice that the caudal pole is considerably higher than in standing position. (No. 5.)

Girl, aet. 20, on her back. Head end of table tilted down about 15 degrees. Ventro-dorsal exposure, immediately after eating two ounces of bismuth in twelve ounces of milk, and then drinking four ounces of milk without bismuth. Caudal pole at pyloric end opposite disc between 12th dorsal and 1st lumbar vertebra. Fundus well filled with bismuth, which is already appearing in small intestines. Upper end of pyloric portion on a level with lower part of 11th dorsal vertebra. (No. 6.)

Same patient on the belly. Dorso-ventral exposure. Notice the spleen influencing contour of greater curvature by pressure against its upper portion. Caudal pole on a level with the navel. In the standing position the caudal pole reached about one-half inch lower than in prone, as ascertained by orthodiagraph.

Girl, aet. 22, on the belly. Dorso-ventral exposure. Stomach vertical and sharply bent at caudal pole like the heel of a stocking at level of navel. (No. 7.)

Same patient standing. Same exposure. Caudal pole six finger breadths below the navel.

Same patient on the right side, dorso-ventral exposure. Right diaphragm higher than the left; heart dropped toward the right. Caudal pole of stomach lower than in prone, but higher than in standing position. Entire lesser curvature well marked. Sphincter of an-

trum and antrum well filled with mixture. Level of fluid well defined. (No. 8.)

A girl, Aet. 25, on right side. Dorso-ventral exposure. Upper level of fluid shown in this position by a straight line. Right diaphragm higher than left. Notice effect of peristalsis on pyloric portion.

Same patient, same position, same exposure. Notice bulging of lesser curvature by weight of bismuth. Pyloric portion differs in shape from preceeding from absence of peristaltic wave. (No. 9.)

Same patient on the belly. Dorso-ventral exposure. Stomach still drawn over to the right from lying on the right side during the two previous exposures. Caudal pole on a level with the crest of the ilium. (No. 10.)

Same patient standing. Dorso-ventral exposure. Caudal pole three finger breadths above symphysis pubis; i. e., six finger breadths lower than in horizontal position.

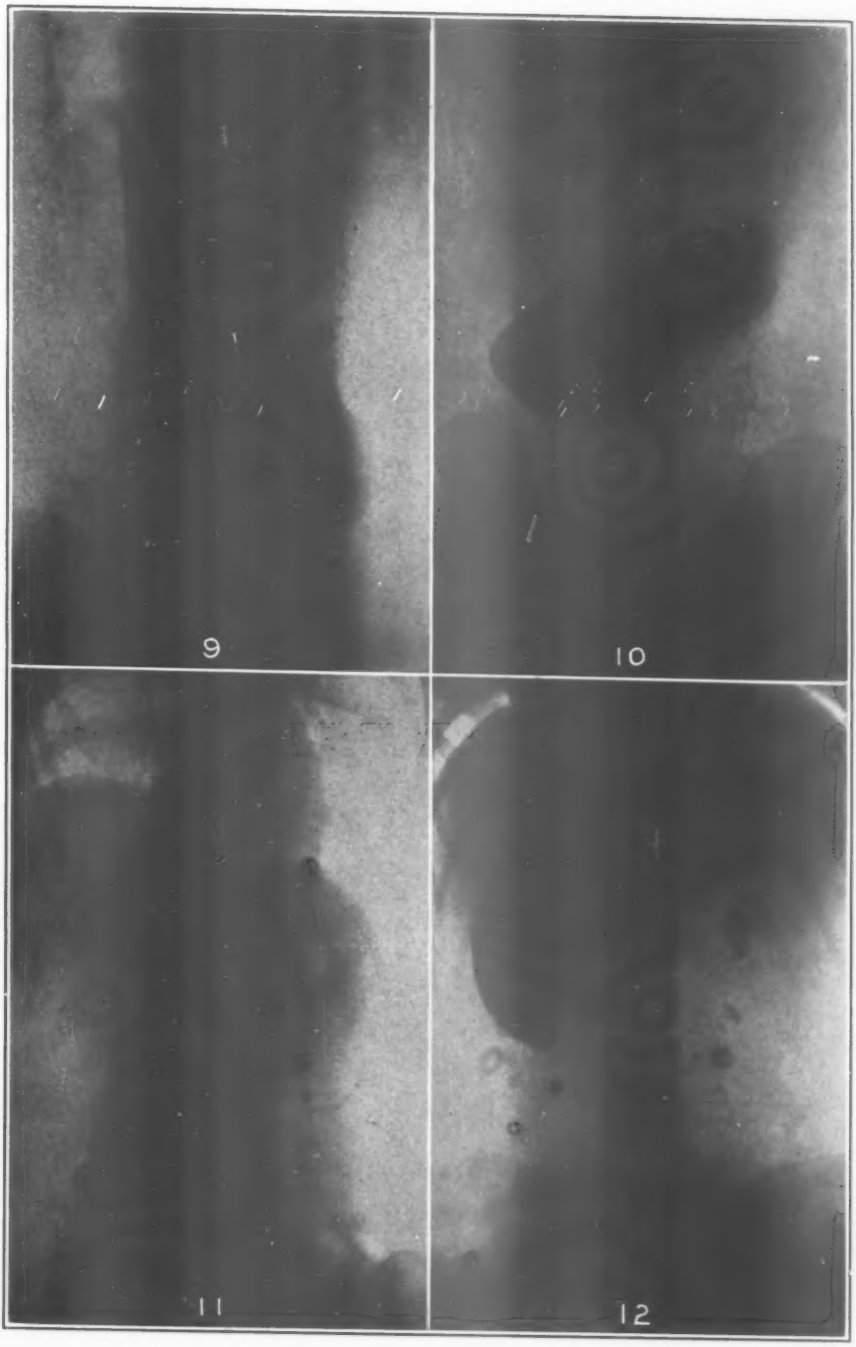
Same patient, same position, same exposure. Notice the hand pressing against the lower abdomen and the effect of pressure upon location and shape of lower segment of the stomach. (What would be the effect, according to the testimony of this negative of a good support and skillful massage?)

Patient female, Aet. 35, on her right side. Dorso-ventral exposure. Lesser curvature clearly shown and bent sharply at pyloric end. Blase small, antrum filled with bismuth. Standing, the caudal pole came down to four finger breadths below the navel. (No. 11.)

Patient a girl, Aet. 14, lying on the belly. Dorso-ventral exposure. Notice the unusual shape of this stomach, with its screw-like twist and seeming break through its middle from peristalsis. Its caudal pole is on a level with lower border of the 5th lumbar vertebra. Standing, it comes down (orthodiagraphic examination) to four finger breadths below the navel.

Same patient on her back. Ventro-dorsal exposure. The stomach is somewhat higher than in No. 1. Though only a few minutes have passed since she took the meal, bismuth shows in the small intestines. (No. 12.)

Same patient on her right side. Dorso-ventral exposure. Notice that again this position seems to give us the entire contour of the greater and lesser curvatures, the pyloric portion, sphincter of the antrum, and location of pylorus. The right diaphragm is higher than the left, and the heart is displaced toward the right. (13.)



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Patient, a girl, Aet. about 28, on her belly. Dorso-ventral exposure. General direction of the stomach is downward and to the left. Caudal pole is on a level with the 5th lumbar vertebra. (No. 14.)

Same patient on her back. Ventro-dorsal exposure. Fundus contains more mixture than with patient on her belly, and caudal pole is still more to the left. (No. 15.)

Same patient on her left side. Dorso-ventral exposure. Shape of stomach in this position is most extraordinary and resembles an almost straight piece of sausage of small cross section. The left diaphragm is higher than the right. Heart is displaced toward the left. (16.)

Same patient on her right side. Dorso-ventral exposure. The right diaphragm is now higher than the left. Heart displaced toward the right. Caudal pole very low for this position. Entire lower curvature covered with bismuth. Supernatant fluid sharply defined above the horizontal line. Gas above the level of the fluid reveals the greater curvature. The contour of the entire stomach, which is much dilated, is shown in this position. (17.)

Same patient standing. Dorso-ventral exposure. Caudal pole three finger breadths above symphysis pubis. Magenblase spindle shaped. (No. 18.)

Same patient, same position and exposure, but taken five days later immediately after another bismuth meal. The colon shows up well by means of the previous mixture, still in evidence. The hand that presses the stomach upward, at the same time presses the transverse colon downward into the pelvis. No. 19.)

A cursory view of the negatives we have gone over rapidly thus far should convince us that an examination for gastroptosis—not to mention enteroptosis—limited to a dorso-ventral exposure of the patient lying horizontally upon his belly, by preventing the elongation of the stomach toward the pylorus, actually accomplishes the very opposite of the purpose for which the examination is undertaken. It does not reveal the degree of ptosis present. It conceals it. It corrects it. A ventro-dorsal exposure with the patient flat on his back is even less suitable for this purpose. Gravity permitting the stomach to fall toward the fundus (its lower part horizontally) this position corrects the existing deformity still further. To emphasize this point I will show two other negatives. They are selected from a series which I made for Dr. Richard Smith to illustrate his work on Enteroptosis, read before the American Gynecological Society

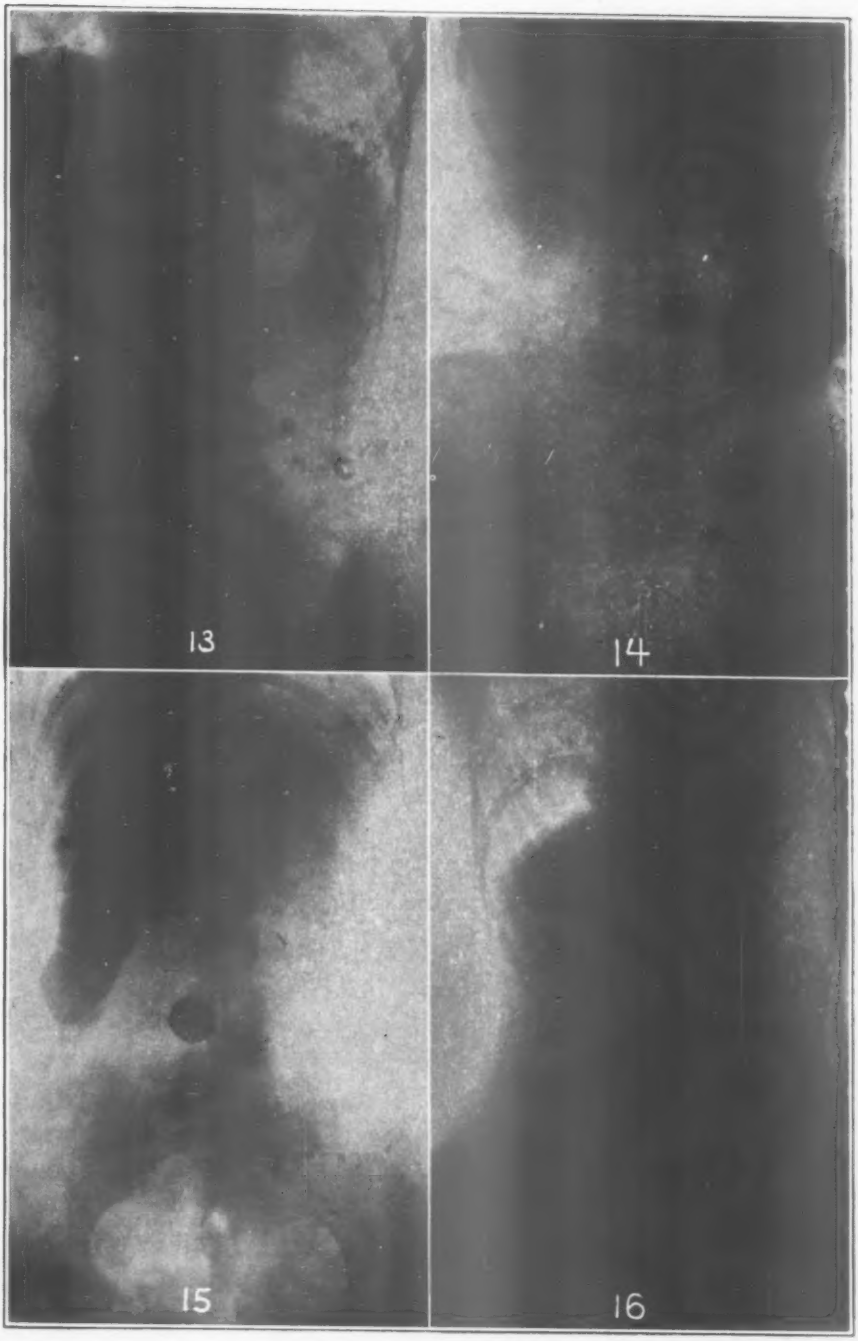
at Hot Springs in May of this year. I am indebted to his kindness for their use to-day.

Nullipara Aet. 24, horizontal on the belly. Exposure dorso-ventral. Caudal pole three finger breadths below the navel. Some of the rugae in the fundus brought out by a slight deposit of bismuth.

Same patient standing. Dorso-ventral exposure 6 hours after the meal. Motor insufficiency indicated by the presence of bismuth still in lower segment and antrum. Caecum and ascending colon filling. In this position the stomach, though almost empty, reaches two inches lower than it did in the prone position when filled.

You may imagine my astonishment the other day when a colleague insisted nevertheless that the prone position is the best and only correct one for determining the position of the normal and abnormal stomach, because "originally man went on all fours." Originally, for aught we know, we may have only swelled the nebular hypothesis, but now that we are no longer in the position of a comet's tail, nor that of an amoeba reaching after our pabulum with pseudopods to satisfy our longing for benevolent assimilation, nor that of quadrupeds whose females were adorned with sixteen breasts, as Dr. Stratz assures us in "Die Schoenheit des Weibes," but have developed into enlightened bipeds blessed with a stomach suited to our high estate, now, to speak with the Doctor in Moliere, "we have changed all that."

Thus far we have said nothing about the examination of the stomach six hours after the bismuth meal to ascertain its motor efficiency, nor about the intestines and the colon, so difficult to locate by ordinary methods of percussion, and transillumination, and, partly for that reason offering a rich field of research to the Roentgenologist, first because we have not the time, and second, because diascopy has added nothing to our knowledge beyond that already furnished by Roentgenography. Aside from this, the steps of the method thus rapidly reviewed (and illustrated by ordinary Roentgenographs) by no means exhaust the possibilities of abdominal orthodiascopy. The probable nature of each case as indicated by its history, laboratory findings, and clinical signs and symptoms, should determine the particular plan of examination to be adopted. Not infrequently the easy method first described will admirably serve our purpose. For a more extended search we may choose to reject the shorter method and select the longer one, or combine both.



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Inflation may reveal a tumor. To bring out the lesser curvature and pyloric end in stenosis or suspected cancer, the horizontal position with the patient on his right side is probably the most valuable of all.

We find, then, to state the matter briefly, that though a Roentgenograph is much superior in quality to anything seen on the fluoroscopic screen, fluoroscopy, especially orthodiascopy, deserves a place in the examination of the stomach. For the simple purpose of locating accurately and beyond a doubt, its cephalic and caudal poles it is quite sufficient.

In fact, for this purpose, it is much better than the ordinary Roentgenograph, which needs to be interpreted according to the law of projection. For the study of motion the passage of the capsules or mixture down the oesophagus, into the magenblase and thence to the bottom of the stomach, for measuring the effect of inspiration (which is greater upon the upper than the lower pole of the stomach) or that of voluntary contraction of the abdominal walls (which affects the caudal pole more than it does the diaphragm), the advantages of the screen are apparent. And when we add to this the ease with which the filling and distended stomach can ve viewed from every direction, the patient tilted with his head downward or in the horizontal or erect position, the advantages of diascopy over the slow and laborious photographic process become for certain purposes more striking still. To discard the latter altogether, however, except for purposes of teaching and illustration, as Holzknecht would have us do, is to be content with half instead of the whole. What we want is not merely Roentgenography or Roentgenoscopy, but Roentgenology.

A year ago I refrained from generalizing on the thirty cases I had then examined, and although the number has more than doubled since then, I still feel no vocation that way. The gastro-enterologist, not the Roentgenologist, should take up the physiology, pathology, and topographical anatomy of the stomach and intestines, and go over the field again by the light of this invaluable method; meanwhile a few remarks may not be out of place.

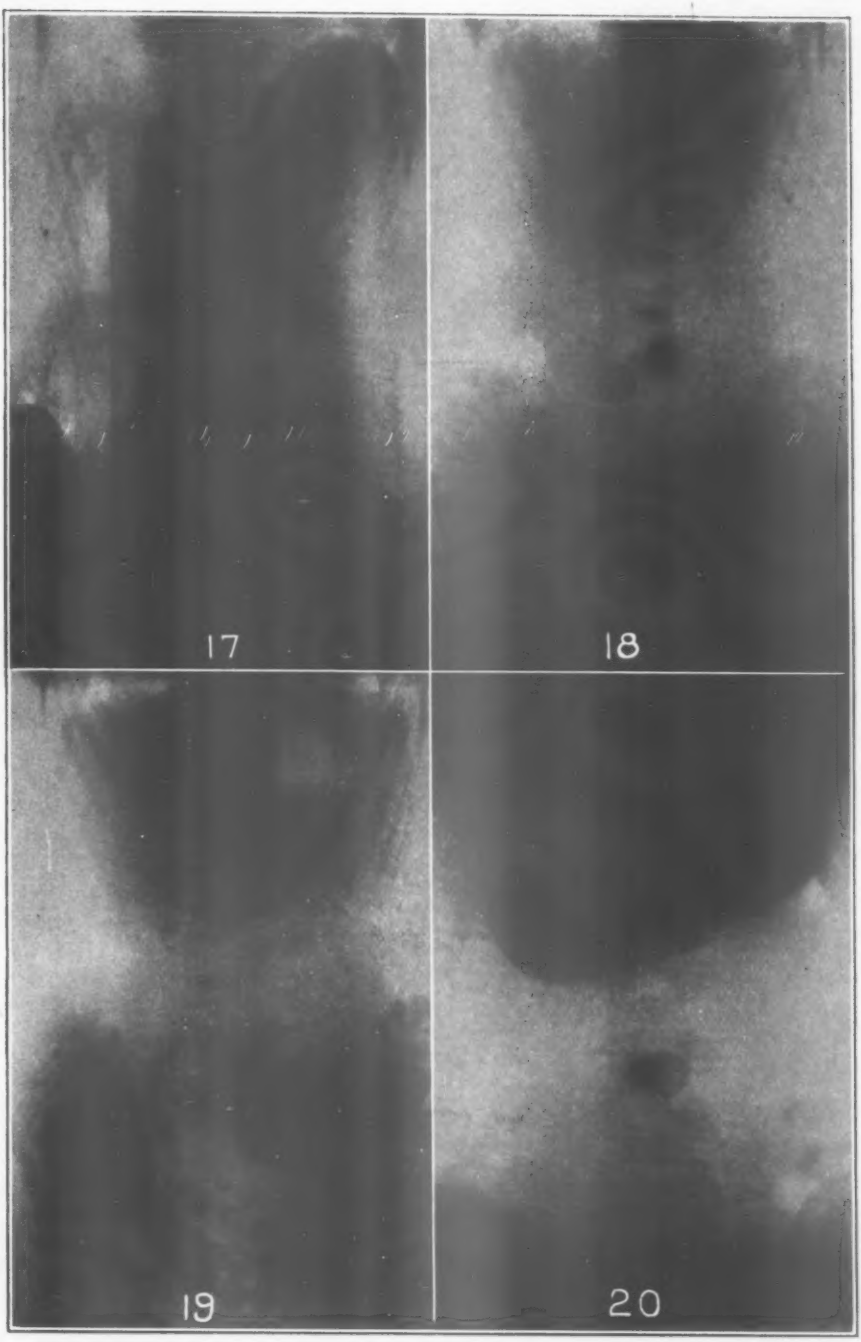
"Stomachs, like noses, may vary considerably in size and yet be within normal limits, but when they extend in the empty condition, much lower than a point midway between the sternum and umbilcus, they are generally pathologic," says Reed. As great a diagnostician

as Boas admits, however, that the lower border of the empty stomach is not located with any degree of certainty. Reed's normal stomach retires, therefore, into the limbus of obscurity where no one (except a Roentgenologist) is likely to find it. The negatives we have just gone over have demonstrated that the prone position, especially with the patient on his back, is faulty, as it fails not only to bring to light the existing ptosis, but actually obscures it, corrects it. And yet it is safe to say that most examinations are still conducted in this way. No wonder Holzknecht asserts that "clinical literature is unacquainted with the normal stomach." At any rate, such pictures of it as you see in books on diagnosis you will probably never obtain from living subjects by means of the Roentgen rays.

Again, authors by no means mean the same thing by the word normal and abnormal. Thus the statistically most common stomach, the stomach which is in the majority, so to speak, is referred to by some as normal; others, like Reed, for instance, in the passage quoted, seem to mean by it a stomach which gives the owner no trouble.

Unfortunately for the theory, trouble does not always show itself in its seat of causation, so that we are not always sure whether an organ causes trouble or not. We find people with the stomach and colon in various positions, who nevertheless present no symptoms prima facie referable to this organ. Statistics will not help us to find out what is normal. We must get at it some other way, and carefully avoid all dogmatism. Now it is a significant fact that a relation exists between the general conformation of the body and the position of these organs. Becker and Lenhoff divide the jugulo-public distance by the waist measure, and multiply by one hundred. If the result is greater than 77, the right kidney will presumably be found palpable. This is probably not quite correct, but it is at least a recognition of the general fact that the habitus phthisicus is the habitus enteroptoticus as well. To both belong the sharp epi-gastric angle, slanting ribs, narrow lower thoracic aperture or paralytic thorax, and vanishing lumbar curve calling for the compensating bustle, as Mathes points out.

Now we find that stomachs of people built that way differ only in degree from a certain type unfortunately but rarely encountered in women at least, and then only



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in such as approach most nearly the standards of classic beauty.

This type of stomach is presented by Case No. iv., as reported by me in The Physician and Surgeon of Sept., 1905, and described as "horn-shaped." Case No. xiii. of the same article, though one of transposition of all the viscera, is a second instance, and was described as "comma-shaped, larger end upward." Later Holzknecht by a curious coincidence, found the same resemblance of this type of stomach to a slightly curved cow horn. This type of stomach has one peculiarity in which it differs from all others; it descends but very little, if at all, upon assuming the erect position.

Stomachs that never look twice alike do not belong to this class; variability of form and position characterizes the stomach of the enteroptotic habit. On the contrary, the type of stomach which we now accept as normal is always in the same place, and is of the same shape. It is not vertical; it's caudal pole is well above the navel and represents the pyloris. It extends obliquely downward and is unlike anything seen in Buttler, Musser or Sahli. The nearest approach to such a normal stomach in a woman, among the negatives presented by me to-day are those of Series vi. There was but one and one-half inches difference in the position of the lowest point of the greater curvature in the prone, and in the erect position, and her stomach corresponded in this with her figure, which was one of the best I have evei examined. Mens sana in corpero sano. Furthermore, we may expect a normal stomach in a perfect body.

We may generously concede that a saint may be enteroptotic and still be a saint, though insisting that the true, the beautiful and the good are one as well as three. We draw the line, however, at enteroptotic Apollos, and gastroptotic Venuses. Present me a Venus and I will demonstrate to you a comma, or cowhorn-shaped stomach, whose lowest point is at the pyloris.

Last Friday after finishing these sentences, two sisters were brought to me for examination. Both were beautiful. E. Aet. 17, measured 5 ft. 2 inches in height, bust measure 33 inches, waist measure 26 inches, jugulopubis distance 21½ inches. N. Aet. 15, height 5 ft. 2 inches, and eight times the length of the head; waist measure 27 inches, circumference of bust over nipples 36 inches, jugulo-pubis distance 21½ inches. The latter

is the most perfect figure I have found, and the former is not much inferior.

I wish to show you the negatives I obtained, one of each, in the prone horizontal position, dorso-ventral exposure. Unfortunately these were the only plates I had left, and were no longer fresh. (No. 20.)

E's stomach reached to one finger breadth below the navel in the standing position; N's to three finger breadths above the navel. In the dorso-ventral position, as these pictures demonstrate, E's was three inches, and N's but one inch higher. Both stomachs, but especially that of N, who possesses the better figure of the two, are typically cow-horn shaped, or comma shaped, its point corresponding to the pyloris being lowest.

Not aiming at an exhaustive discussion of the subject, I purposed to place before you this further development of the work I presented one year ago. Instead of speaking after the manner of presidents, I chose to address you as a fellow, and while I thank you as such for your attention, I conclude by thanking you also for the pleasure and the honor of the presidency of the American Roentgen Ray Society.

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*THE X-RAY DIAGNOSIS OF RENAL CALCULI.

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In presenting this paper to the society I realize that my subject to a certain extent is an old and hackneyed one. My connection, however, with the Johns Hopkins Hospital has afforded me such an unusual amount of material and some of it at the same time so interesting that I thought it might be of interest to the society to hear of our results. We can safely say that since the advent of the X-ray, the diagnosis of renal calculi has become almost a certainty. We still meet medical men, however, who have no faith in the diagnosis of calculi by means of the X-ray. This attitude of mind can be attributed to two causes, the disappointing results arising from carelessly taken skiagraphs and the dread of X-ray dermatitis. The popular opinion still prevails among the medical profession that the diagnosis is merely a case of photographing the kidneys. Shenton says, "Such an examination is not merely photographing a patient's kidneys, a foolish and prevalent expression, prevalent because of want of knowledge generally among the profession of the things pertaining to the rays, foolish because it is rare in the skiagraph of the abdomen to see the kidneys, for, as a rule, the less that is seen of the kidneys the more chance there will be of seeing the calculus." Examination by the radiographic method is the one most generally employed, though one well known skiagrapher maintains that the fluoroscopic method is the more accurate and delicate. He says, "One might draw a parallel between the faint shadows seen upon the screen and the faint sounds heard in a stethoscope. To the untrained eye or ear neither have significance, yet it is possible that a careful study of the ghostly screen effects may lead to a more delicate and perfect method of ascertaining the conditions of the abdominal organs . . . . . However this may be, the search for calculi is an established and comparatively simple process."

Fenwick suggests the examination of the kidney at operation. His method is to bring the kidney out of the incision and then examine it fluoroscopically. This method,

Read by invitation before the 7th Annual meeting of the American Roentgen Ray Society at Niagara Falls, N. Y., August 29 to 31, 1906.

however, as he points out, would not always be possible, as in some patients the blood vessels are too short to permit it.

We use the radiographic method entirely. The procedure employed is briefly as follows: Before examination the patient's bowels should be well evacuated. He is then placed in the dorsal position, legs slightly flexed so the back approximates the table. All clothing both upon the back and abdomen is removed to avoid the possibility of a shadow of some extraneous object (a button) being mistaken for a calculus. The plate is placed beneath the back, its upper margin reaching the eleventh rib and the lower border, the ileum. An 11x14 inch plate is used, as its size is sufficient to cover both kidney regions, and as it sometimes happens that calculi are found on the side opposite to that in which the pain is felt.

The tube is placed directly in front of the patient in the median line just above the umbilicus and from ten to fourteen inches from the abdominal wall. If the radiograph is good the twelfth rib, the transverse processes of the vertebrae, the crests of the ilia and the psoas muscles are readily seen. With such data one has, as a rule, sufficient differentiation to determine the presence or absence of a calculus either in the kidney or upper portion of the ureter.

A second exposure should be made. This time the upper margin of the plate reaching the crests of the ilia and the lower margin being well below the trochanters. The tube is placed in the median line, but this time half way between the symphysis and umbilicus. In this position the rays fall in the line of the pelvic canal and thus the possibility of having the ureters projected upon the sacrum is avoided.

This second plate gives that portion of the ureters lying within the pelvis. With a renal calculus the most common situation is in the angle formed by the last rib and the spinal column. A light shadow with rather a definite border in this situation should always be viewed with suspicion. Occasionally such a shadow will be found midway between the tip of the last rib and the crest of the ileum. In such cases if a stone, the abnormal position is due to a misplaced kidney. Any suggestive shadows lying external to the twelfth rib may generally be disregarded, as they are too far out to be in the kidney. If, however, we have a very large kidney distended with calculi, then the shadows will extend beyond the twelfth rib. In the vast majority of cases such shadows, however, are generally

due to some shadow casting substance in the intestine.

While theoretically calculi may be found anywhere in the ureter practically, they rarely occur except in the lower two inches of its course. The presence or absence of these stones is determined by the radiograph of the pelvis.

A line drawn from a point one-half an inch internal to the pubic spine to the sacro-iliac articulation roughly gives the position of the ureter. A light shadow occurring in this line may be regarded as a calculus. Care must be taken, however, not to confuse such a shadow with one cast by a phlebolith. This region is richly supplied with veins and it is quite common for phleboliths to form in them. The shadows cast by these concretions, however, are more definite and their edges are more sharply defined. Then, too, they are smaller, rarely exceeding 3mm. in diameter.

Since the conditions which lead to the formation of phleboliths are usually present in all the veins in this region, these concretions are apt to be multiple. Where the diagnosis is in doubt between the two conditions, the presence of one or more similar shadows elsewhere would indicate the shadow to be that of a phlebolith. In some of the doubtful cases the diagnosis may be settled by the ureteral catheter, though in one case in the records of the Johns Hopkins Hospital a small stone lay in a pouch in the ureteral orifice. A catheter could be introduced with ease, passing over the stone.

Recently a soft flexible catheter with some shadow casting salt incorporated in its substance has been devised by Fenwick. This is introduced and the radiograph is made. If the suspicious shadow is a stone it will be in the line of the catheter, but if it is a phlebolith it will be external to the catheter.

Occasionally a calculus may occur in some other portion of the ureter. In such cases it will show as a light shadow about two inches from the vertebral column. In three only of 351 cases examined for calculi were they found above the brim of the pelvis.

Thus far, the chemical composition of the stone has not been considered. Since the sharpness of the shadow depends upon the density of the object radiographed, naturally those can be represented best which consist of inorganic matter, that is, a mineral substance such as the salts of calcium. Those made up largely of organic matter cannot be so easily radiographed.

Calculi may be roughtly divided into oxalates, phosphates and urates. If a specimen of each class is placed upon a photographic plate and a radiograph made, one finds that the oxalate casts a dense shadow, the phosphate, being more permeable to the rays, casts an indistinct shadow, and the translucent urates scarcely any. Thus success or failure is somewhat dependent upon the chemical composition and, consequently, upon their opacity to the rays.

In the earlier days of this method of examination the detection of pure uric acid calculi was uncertain and difficult. A few years ago Albers Schönberg devised an apparatus by means of which we could not only compress the abdomen, but also cut out all secondary rays and thus do away with the fogging of the skiagraph. With the aid of such a device skiagraphs are obtained so rich in contrast and detail that even these calculi can be detected. The beautiful work of Albers Schönberg and others furnish striking examples of this fact. Our experience with the compression diaphragm has been so extremely good that we would not be without it. Whereas it is valuable in all kinds of radiographic work, it is of most value in kidney work. Repeatedly in large subjects we have succeeded in getting the shadow of a stone which could not be obtained by using the ordinary method. In the last two years it has been used practically in all cases of suspected calculi.

While it is true the percentage of failures is becoming smaller each year, it is unlikely that absolute accuracy will ever be obtained in this as in any other method of diagnosis. Mistakes in diagnoses fall under two heads; first, those cases where calculi were found at operation, but not by X-ray, and secondly, where the ray found calculi, but diagnosis was not confirmed at operation.

Many failures result from carelessly taken skiagraphs. Detection of calculi is by no means easy, and accuracy can only be obtained by careful work and long experience.

The chemical composition has already been mentioned and one can readily see that a small uric acid calculus might not cast a shadow. The size is an important factor. A calculus, the diameter of which is less than one-half cm. may easily remain undetected.

Though the stone itself may be of such size and chemical composition that one would expect its detection an easy matter, the physical condition of the patient may interfere considerably with the diagnosis. Since the detection depends upon the differentiation of the shadow of the

calculus from that of the tissues, it naturally follows that the greater amount of substance the ray has to penetrate before reaching the calculus, the less contrast there will be between it and the surrounding tissues, consequently in very fat individuals a small calculus may be easily overlooked. Intestines filled with fecal material may so obscure the renal and ureteral regions as to make it impossible to locate the stone. In this connection it is well to emphasize the point of always having the patient's bowels well evacuated before making the examination.

Those cases in which the ray found a stone but the surgeon found none are not so frequent. It may happen that during the operation the manipulation of the kidney dislodges the calculus and causes it to change its position. This is well illustrated in a case which came under my observation. A small calculus was found in the kidney by the ray. During the operation the surgeon experienced great difficulty in freeing the kidney and consequently the organ was extensively manipulated. Upon opening the kidney no calculus was found. The symptoms persisted after operation and a second skiagraph was made. This time no calculus was found in the kidney, but one was shown in the ureter just above the brim of the pelvis. Soon after the patient was seized with another attack of renal colic and in a short time passed a small stone that corresponded in size and shape to the one found first in the kidney and later in the ureter.

The salts of heavy metals, such as bismuth subnitrate, cast quite dense shadows. One case has been reported in which a patient had been taking large doses of bismuth subnitrate. During the administration of the drug, a skiagraph was made and a diagnosis of renal calculus was made from a suspicious shadow in the kidney region. The patient was not operated upon and some weeks later, when a second examination was made, no calculus was found. In this case the subnitrate in the intestines evidently cast the shadow which was taken for that of a stone.

A purulent exudate in the pelvis of the kidney when inspissated and containing deposits of calcium salts, may cast a shadow indistinguishable from that of a stone.

A patient was admitted to the wards of the Johns Hopkins Hospital with the diagnosis of renal calculus. The skiagraph showed a large, well-defined shadow in the left kidney about 3cm. in diameter. At operation upon exploring the kidney pus was found encapsulated by fibrinous tissue lined with a thin layer of calcium salts.

Suspicious shadows simulating those of calculi may be caused by dense cicatrices in the kidney. This is well illustrated by the following case. The patient had had a severe infection of the kidney and subsequently passed several small stones. Two years later he had attacks of renal colic and a skiagraph was made. In the kidney on the affected side three distinct and well defined shadows could be seen. With the history of having passed calculi, diagnosis of renal stone was made. At operation, however, no calculi were found, but a small contracted kidney and in it were masses of dense cicatricial tissue which had cast the misleading shadows.

The question naturally arises: In what percentage of cases does the use of the X-ray enable one to arrive at a positive diagnosis of the presence or absence of calculi? This varies. Some radiographers maintain that an absolute diagnosis, either positive or negative, can always be made; others say that the diagnosis is very uncertain. The personal equation enters so largely into the question that an absolute standard cannot be fixed.

From the series of cases examined at the Johns Hopkins Hospital certain data may be cited which indicate the value of this method. In this series of cases there were some in which the skiagraph showed calculi to be present where the clinical signs did not more than suggest the possibility of this condition. There were those in which the patient had had no symptoms that in the least suggested calculus and the examination had been accidental.

There was still another class, and the most interesting, in which the symptoms pointed so strongly to calculi that an X-ray examination was almost deemed unnecessary, yet neither the skiagraph nor the surgeon were able to demonstrate the presence of calculi. This last series of cases to me are the most interesting. I have had over a score of such cases with typical history of renal colic. Practically all gave the history of sudden attacks of violent pain, so intense as to cause nausea, always followed by bloody urine which would clear up in a day or two. The X-ray findings were absolutely negative and a number of the cases when explored showed an absolutely normal kidney and ureter. The interesting feature in connection with them is that all came from comparatively the same section of the country, namely, the Carolinas.

In the past four years 354 cases have been examined for renal or ureteral stones. In 85 cases calculi were found by the ray, 60 of these were operated upon and the diagnosis confirmed by the surgeon. The remaining 25 for various reasons have not been operated upon.

Of those in which a negative diagnosis was made, 72 were explored and in one case only were calculi found. The remaining 197 cases were not explored and subsequent history seems to confirm the negative diagnosis.

From these figures it will be seen that the positive evidence is absolutely reliable; the negative not entirely so. However, the negative evidence should have weight in absence of symptoms definitely indicating the presence of a stone.

The location of the calculi was as follows: Of the positive cases calculi were found 47 times in the kidney. In two cases only were both kidneys affected.

In six cases the stones were multiple. In two cases they were present both in the kidney and ureter.

Of the 38 cases of calculi in the ureter, in three cases only were they above the brim of the pelvis. In the remaining 35 cases they were lying in that portion of the ureter contained in the bladder wall.

The calculi varied in size according to the situation, those in the ureter ranging in size from a small pea to a date seed. In the kidney from one-half cm. to eight cm. in diameter.

In conclusion, it may be said that with good apparatus and technique calculi when present can practically always be found. The X-ray examination gives definite and positive information as to the location, number and size of calculi present. As already pointed out, it shows the position of the calculus whether in the kidney or ureter. This simplifies the operation and the surgeon is less likely to overlook a stone when more than one are present.

An X-ray examination should always be made in suspected cases. This is not dangerous and, furthermore, gives no discomfort to the patient. Indirectly the examinations are of great benefit to the diagnostician, as they enable him to define more sharply the symptoms associated with the presence of calculi and associate characteristic groups of symptoms with its presence he is not now able to connect with the disease. In this way the X-rays will increase the possibility of making clinically a more definite diagnosis of this condition.

DISCUSSION OF DR. BAETJER'S PAPER.

DR. CHARLES LESTER LEONARD, Philadelphia:—I have very little to add to the doctor's paper. I congratulate him on his excellent results. I feel that the work is being widened. I notice it particularly in my own practice. The results are always improved on. Taking my last 150 cases, I doubt that the error is one-half of what it was in the first 200 cases examined, whether in positive or negative diagnoses. In fact, my negative diagnosis has been more accurate than the positive.

The particular thing in which I am interested is the prognosis with reference to treatment; the possibility of calculi passing. Since my last report I have had eight cases where the patients passed the calculi after the diagnosis had been made. This relieves the patient from the necessity of a serious operation and puts him in the position of absolute safety and yet have all the benefits of the best treatment possible.

The differentiation between phlebitis and stone is one of the greatest importance. I think that Dr. Kelly, in his work on the female, has made a step very much in advance in using a ureteral catheter the substance of which is impregnated with bismuth. Of course, the use of the stylet is possible, and it has been used successfully in a number of cases. The flexible catheter is perfectly safe, but when that catheter can be made opaque it is very much better and simpler than to use a stylet.

The differential diagnosis can be facilitated, and always is, where the kidney itself is shown in the picture together with the ureter. Dr. Caldwell showed me some excellent pictures of this kind. I had the misfortune of making a diagnosis of calculus where it was a case of stricture of the ureter with occlusion and gravel above it. The patient was operated on and the real condition was disclosed. Then the surgeon went up to the kidney and found a surgical kidney. He did a nephrectomy. That was a mistake in diagnosis, but operation is always indicated where these shadows are found.

Quite a paper could be written on anomalies found by the X-ray where there was other than stone present, but I am sure that the better definition which we are all getting is making our diagnosis more simple and surer than it has been. If we could all make plates such as Dr. Hulst showed us we would not need a compression diaphragm to make our pictures. I use 12x20 plates. They take in the whole urinary system from the upper pole of the left kidney down to the symphysis pubis. Then you can see both kidneys and their ureters, and by comparison you can make a fairly accurate diagnosis as to the condition present.

DR. GEORGE E. PFAHLER, Philadelphia:—I am sure that we all recognize the value of the work done by Dr. Baetjer. I would like to have him tell us how many plates he uses in making an examination of both kidneys, both ureters and the bladder, and how long he exposes in each instance. It is valuable for us to know this so as to perfect our technic for doing this sort of work.

I seldom use compression, although I have a compression tube. I do use a diaphragm, however, and I think it amounts to at least 99 per cent. of the compression diaphragm technic. I use a square diaphragm, one that will just cover an 8x10 plate at a distance of eighteen inches. I usually examine both kidneys, both ureters and the bladder. I use one plate for the kidneys, one for the ureters and another which takes in the bladder. That makes four plates in all. I try to make my exposure during the time the patient holds the

breath, in from five to twenty seconds, so as to avoid the movements of the kidneys caused by the excursion of the diaphragm during respiration.

DR. GEORGE C. JOHNSTON, Pittsburg, Pa:—I would like to call attention to a peculiar condition which I found in a patient about two months ago. A woman, aged 24, a neurasthenic had typical symptoms of stone in the ureter, and such a diagnosis was made by a good genito-urinary surgeon. The urinary findings were positive. At the time she came for examination she was suffering from a typical attack of renal colic, and the surgeon gave her a hypodermic of morphine so as to permit me to make the exposure.

I always use two plates, one superimposed on the other, and on developing them I got a very good picture, and both plates showed a very distinct shadow in the region of the left ureter, about one and a quarter inches above the point of entrance into the bladder. In view of the undoubted character of the symptoms and the brilliancy of the shadow I had no hesitation in pronouncing the case one of stone in the ureter.

The surgeon operated and cut down on the ureter by the extraperitoneal route. Meeting me the next day he expressed himself as being very well pleased, but that if he had known the actual conditions he would not have gone in there. While he found a stone, yet it consisted of a small calcified uterine fibroid which was adherent to the ureter and was compressing its lumen, thus producing a hydronephrosis of the kidney.

DR. HENRY HULST, Grand Rapids, Mich:—I wish to disclaim the conclusion drawn by Dr. Leonard. A very fine picture of the abdomen will no doubt be sufficient to make a positive or negative diagnosis. It is just as true, however, that in skiagraphy one can improve the technic by using a compression diaphragm, providing it is a good one, and, especially, if the subject is a fat one. In the case of a small spare person it is not necessary to use a compression diaphragm. One can work more rapidly if it is not used, but when you get a patient weighing 230 pounds, you will be very glad to use the compression diaphragm, especially if the stone is a small and a soft one. Pictures will be improved by cutting out the rays which blur them and that is the function of this diaphragm.

Most diaphragms have faults. A fault referred to awhile ago, which, for most purposes, I should consider a virtue, is the small diameter. The smaller the diaphragm, the smaller the opening, the better the picture. By using a diaphragm having an opening two inches in diameter, you will get results you never dreamed of before. Take the fluoroscope and get beneath the apparatus and you will find plenty of rays which you want to cut out. This part of the apparatus wants to be made better. Take a piece of lead as thick as your finger, use a Walter six tube and use a powerful current and the ray will go through all right.

Then make the canopy very large and have it lined with thick lead so that no ray goes around it nor through it. If there is any doubt surround the tube with a good shield besides and cut out every bit of ray.

As to the effert of compression. This is not appreciated as it should be. I was never so much impressed with the effect of it as when I began my orthodiagraphic work of the stomach. As the patient stands up before the fluoroscope you see the organ, and as you compress the patient against the fluoroscope or the fluoroscope against the patient the whole picture changes. Whereas before you may have

had a blur, if you only compress your fluoroscope against the patient your results become different and the stomach stands right out. It is very surprising how a little pressure will produce a great difference in the picture. Pressure with this instrument makes a greater difference still because the pressure is greater and the field smaller.

The pictures I showed you of the stomach I should consider very bad pictures if they were not so large and had been taken with a good instrument of this kind. The spine as it is shown in those 14x17 plates is as good as I can make it without selecting my cases.

The question is how we can do the best possible work at the present stage of our art. I am quite convinced that there is no man who can afford to dispense in work of this kind with any of the accessories at our disposal. A poor compression diaphragm had better be dispensed with. A very fine one will come in handy, especially in the case of fat subjects. In patients of small size it can also be dispensed with, although personally I always use a compression diaphragm in kidneys cases.

I think it is good practice to use a large plate for general orientation, and small ones in the camera for localized examination, and we must not try to do too much at one time. With a kidney case I am willing to spend an hour and a half. Do the very best work you can; take as much time as may be necessary, and charge accordingly.

I never make a diagnosis on a single sitting. If I find a stone, I have the patient wait for a few days or longer, if I have exposed him very much. Of course, if the case is an urgent one you cannot do that. If after having exposed a second time you get the same shadow in the same place, of the same shape, and everything else the same, then make your diagnosis.

DR. PERCY BROWN, Boston:—The entire subject of the Roentgen diagnosis of renal calculi is a very complicated one. It seems to require especial care in every step of the procedure. It does not seem to me that enough emphasis has been placed on the preparation of the patient before operation. Usually medical men in my neighborhood are ignorant of the Roentgen method of diagnosis of renal and other calculi, and I do not doubt that this is true in other sections of the country. No doubt many of you have received a request to diagnosticate renal calculus at a moment's notice, without any preparation of the patient whatsoever.

I always request the doctor to give his patient a thorough cleaning out as to the bowels, and then to instruct the patient to partake of a moderate meal beforehand, so that the stomach will be as empty as is possible. By doing this you have accomplished thirty-three and a third per cent. of a good result.

DR. BAETJER, closing the discussion:—In regard to Dr. Pfahler's question. I use an 11x14 plate, and I make first a general picture of the abdomen as far as the crest of the ilium. Then I make a second plate of the ureter contained in the pelvis. I never rely on the general picture for accurate diagnosis. I make a series of compression pictures so as not to expose the same plate twice.

I find that I get better results by exposing a little longer than most operators do. I rarely make an exposure of this kind in less than three minutes, and when using the compression diaphragm, in five or six minutes. If the patient is very fat, I take more time. In one case I took nine minutes and the radiograph was a very good one.

The distance of the tube will vary, of course.

I agree with what Dr. Brown said. In the hospital I have all

my patients take a brisk cathartic the night before and on the following morning an enema is given. When there is any doubt whether the stone is in the kidney, I have the patient wait for a week or ten days, when I make another exposure. I do not do this because I fear a dermatitis, but I want to make my diagnosis all the more positive.

SKIAGRAPHY OF THE ACCESSORY SINUSES OF THE NOSE.

By E. W. Caldwell, M. D., New York.

The use of the Roentgen ray as an aid to diagnosis in certain diseases of the accessory sinuses of the nose was brought to my attention a little over two years ago by Dr. Coakley, of New York, and Dr. Ard, of Newark. Dr. Ard had just returned from the clinic of Dr. Killion at Freibourg, and had brought with him some excellent plates, in which the outlines of frontal and maxillary sinuses and the ethmoid cells were distinctly shown. On one of these plates there was an increased density of shadow over one of the frontal sinuses, which was believed to indicate pus in the cavity.

There is, in different individuals, such wide variation in the size of the frontal sinuses, in the number and position of their septa; and occasionally such a great lack of symmetry, that the use of the X-ray in this region would be fully justified even if it could give us no other information than the anatomical details just mentioned.

Therefore, at the suggestion of Dr. Coakley, I at once began making radiographs of cases from his clinic at the University and Bellevue Hospital Medical College. To this clinic and to the anatomical department of the college I am indebted for splendid material for a series of experiments which were directed toward securing a good technique for making radiographs of such cases, and for determining their practical utility to the rhinologist.

This work was carried on at the Edward N. Gibbs Memorial X-Ray Laboratory, which is the Roentgen Ray department of the college.

Read by invitation before the 7th Annual meeting of the American Roentgen Ray Society at Niagara Falls, N. Y., August 29 to 31, 1906.

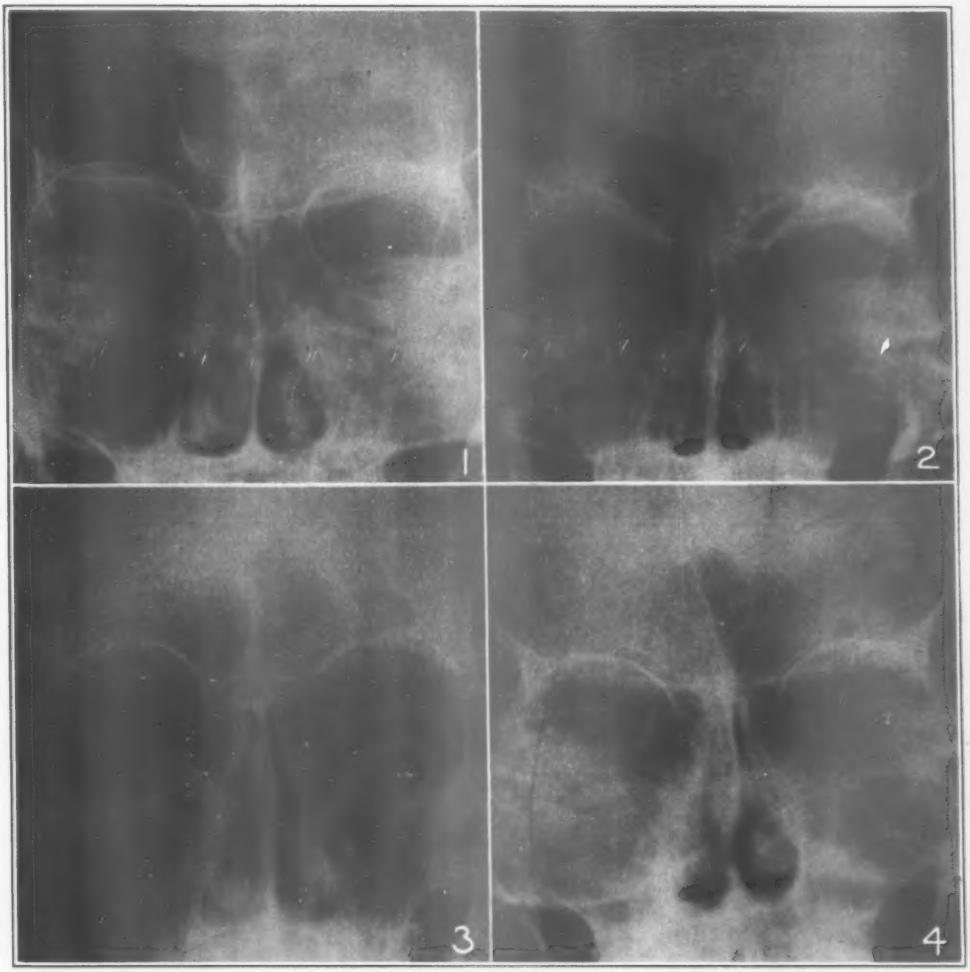
By comparing the frontal sinuses of several cadavers with the radiographs made of them, it was readily shown that the extent of the sinuses, and the location of their septa could be determined by the X-ray with sufficient accuracy for the purpose of the surgeon. The indications given by the X-ray of diseased conditions in the sinuses of patients from the clinic were confirmed in many cases by operation and by other means, but it seemed desirable to make further experiments to determine why the X-ray indicated such conditions, and how much reliance could be placed in these indications. Some experiments with this end in view were therefore carried out by Dr. Chisholm and myself.

It seemed probable that the increased density of the shadows of diseased sinuses was due chiefly to an increase in the amount of fluid in the cavity, either in a swollen and edematous lining membrane or a collection of exudate or pus. Radiographs of specimens of pus and exudates from various sources show that their opacity to X-rays was practically the same as that of a normal saline solution, or of pure water. This was determined by radiographing at the same time equal volumes of the various fluids in little thin celluloid dishes of exactly the same size and shape.

A piece of mucous membrane from a cadaver was cut in half. One piece was kept moist by placing it in a sealed jar while the other piece was dried. The radiograph of the two pieces showed that the water in the moist specimen cast a shadow many times as dense as that cast by the solids of the dry specimen.

We then made radiographs of some heads of cadavers before and after filling parts of the sinus cavities with water or with pieces of moist mucous membrane introduced through trephine openings. It was easy to detect the added liquid and membrane in the radiograph, but the rather large trephine openings were objectionable and it was found very difficult to keep the liquid from leaking out of the cavities. Dr. Coakley then made the very practical suggestion that we use moist gelatin instead of water or membrane for filling the cavities, and the demonstration was then repeated with more refinement in detail. Control radiographs were first made to show that the opacity to X-ray of the moist gelatin was practically the same as that of the water or pus or edematous membrane.

Radiographs of the heads of some fresh cadavers were made. Then the scalp was turned down over the frontal bone until the supraorbital ridges were exposed.



1. Very large frontal sinuses with many septa. Fluid is shown in right frontal and right maxillary sinuses. Operation by Dr. C G. Conkley demonstrated that these cavities were filled with pus.

2. Asymemetrical frontal sinuses. In this case, trans-illumination was misleading. The principal angle is a little too small and the shadows of petrous bones are shown over lower third of orbit.

3. Frontal sinuses rather large, but contain no fluid. The left maxillary sinuses contained small amount of pus. The transverse line across upper third of orbits show the limit of shadow of horizontal plate of frontal bone. The principal angle is approximately 25°.

4. Left frontal and both maxillary sinuses filled with pus. Principal angle a little too small for best results.

By means of tracings from the first radiographs, the frontal sinuses and their septa were outlined in ink on the frontal bones of the cadavers. Then by using a small drill, directed downward and backward from points above the superior limit of the sinus, we were able to enter unerringly the different cavities formed by the septa. By means of a small syringe needle introduced through the drill holes, we were able to show that these cavities contained no fluid. We then injected into some of the cavities gelatin which was just warm enough to flow through the syringe needle, and which solidified immediately after. The scalp was then replaced, and more radiographs of the head were made. In these radiographs the empty cavities could be readily distinguished from those filled with gelatin.

These experiments convinced us that the X-ray indication of fluid in the sinuses was fairly reliable,—a fact which had been recognized by our German colleagues before we began our experiments.

In order to use the X-ray successfully for exploring the accessory sinuses of the nose, it is necessary to obtain radiographs of very good quality. Such radiographs are not easy to make. They call for the best possible appliances, and an amount of attention to petty details of technique which the busy clinician is unable, or unwilling to give, and of which he has usually not the vaguest idea.

Owing to the thickness and opacity of the skull and brain, it is necessary to make long exposures, and to use rays of rather high penetration. The use of rays of too high penetration, however, results in a lack of contrast in the negative. Rays of low penetration act more energetically upon the scalp, and longer exposures are necessary with them, in order to obtain sufficient effect upon the photographic plate. Unnecessarily long exposures must be avoided, because they increase the liability of blurred pictures due to movements of the subject, and also because they increase the danger of harmful effects of the rays, both upon the scalp and upon the deeper structures.

The necessity for long exposures, and sometimes for repeated exposure, together with failure to secure the proper degree of penetration and sufficient distance between tube and scalp, sometimes cause X-ray allopecia, and even X-ray dermatitis over the back of the head. Not only these unfortunate accidents, but also the disclosures of Dr. Edsall, of Philadelphia, and others, as to the profound effect of X-rays upon all living cells, remind us of

the importance of working with especial caution and certainty in this region. Indeed, I think it is unwise to expose the same individual during a period of three weeks, for a longer time than is necessary to obtain two or three radiographs in the antero-posterior position.

The danger of X-ray allopecia and dermatitis may be considerably reduced by interposing between the tube and the patient some sort of protective ray filter. For this purpose, I use a sheet of aluminum, 1-50 of an inch thick, very close to the tube, and work with the target of the tube 18 inches from the center of the plate. No accidents have occurred in my practice under these conditions.

It is, of course, necessary to use some screening device to cut off as much as possible the rays originating from the glass walls of the tube. For this reason, most operators use the Albers-Schonberg compression screen, or some modification of it. These appliances, although exceedingly clumsy, are perhaps the best for the purpose which the market affords.

The usual procedure is to place the patient in a recumbent position, face downward, with his forehead and nose resting upon the plate holder, and to adjust the tubular part of the compression apparatus over the back of the head. The usual length of exposure in Germany is two to three minutes, but it is quite possible, with good apparatus, to obtain brilliant negatives with exposures of ten to twenty-five seconds.

The length of exposure, and the degree of penetration depend somewhat upon the thickness of the skull, which varies greatly in different individuals. For determining the degree of pentration of the ray, and for estimating the length of exposure necessary in a given case, I like to observe the degree of fluorescence produced on a barium platinum-cyanide screen by the X-rays which pass through the skull of the subject at the time the exposure is made. This is one reason why I do not use the Albers-Schonberg apparatus. I work with my patient lying face up on a canvas stretcher. I place the tube and diaphragm under the stretcher, support the plate over the face, place a fluorescent screen over the plate, darken the room, and watch the effect of the rays on the screen. Two advantages of this method will be apparent at once. The patient is more comfortable, and hence less likely to move during the exposure, and then, if the penetration of the tube changes and becomes too high or too low, it will become

apparent at once to the operator, and the exposure may be terminated without delay.

The appearance of a radiograph of the face and its usefulness in diagnosis depend much upon the position of the tube and the direction of the rays with reference to the base of the skull. We must avoid superimposing the shadow of the horizontal plate of the frontal bone upon that of the frontal sinus, or the shadows of the petrous bones upon those of the maxillary sinuses, or the shadow of the basilar process of the occipital bone upon that of the ethmoid cells. Any of these undesirable results and some others as well may occur if the exposure is made in a careless manner. The necessity for a standard distance and position of tube is, therefore, apparent.

The direction of the rays with reference to the plane of the photographic plate is comparatively unimportant, and since we must bring the plate as close as possible to the face, this direction will be determined by the prominence of nose and forehead, and therefore subject to considerable variation with different individuals.

The distance of the source of X-ray (the target of the tube) from the face and the plate is, however, of some importance, partly because upon it depends the amount of divergence of the rays which give us the shadow picture. Considerations of safety to the patient and length of exposure are, however, the chief factors which determine this distance. I find that 18 inches answers all the requirements for safety and that this distance does not necessitate longer exposure than about 20 seconds for the anteroposterior projection and 10 seconds for the transverse projection.

In order to secure a standard position for the source of rays we may select one of the diverging rays which produce the picture and measure the angle which it makes with a plane corresponding approximately to the base of the skull. The ray I have selected for this purpose is the ray which passes through the skull in the mesial plane and pierces the center of the glabella. This ray I have called for convenience the principal ray. A suitable plane which can be readily located by external landmarks is the one which passes through the centers of the external auricular orifices and the center of the glabella. To save time I shall call this plane the basal plane and the angle between it and the principal ray, the principal angle. With a fixed distance between the target of the tube and the glabella

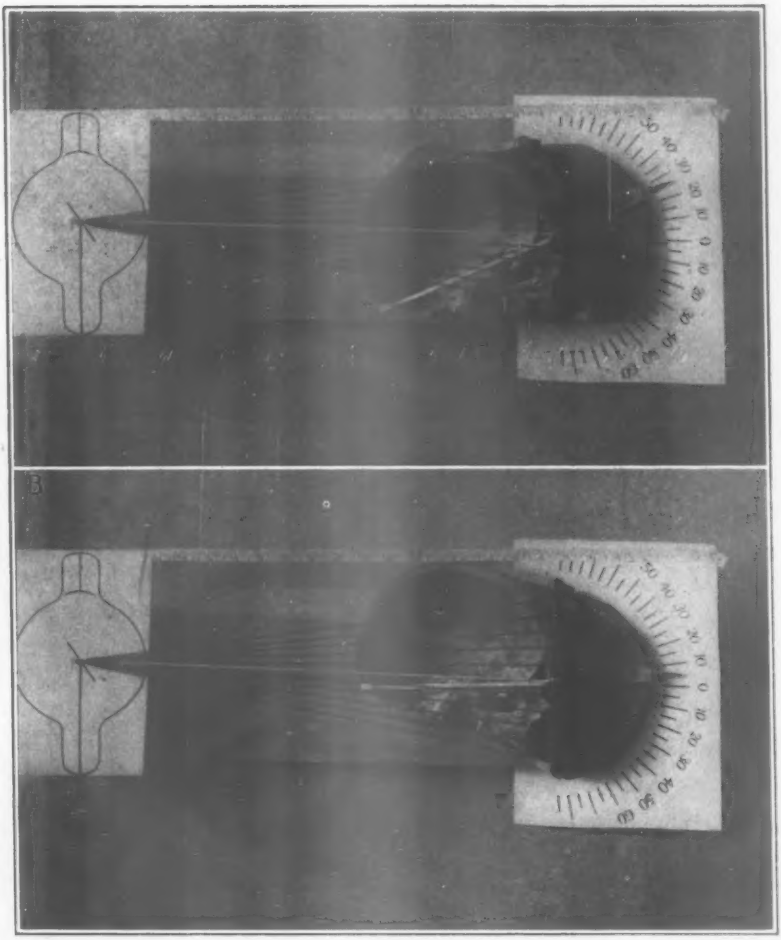
the general direction of the rays may be expressed by the measurement in degrees of the principle angle.

From measurements of a number of skulls which had been split in the median plane, and from a number of radiographs of skulls and heads at different measured angles I have found that, with the target 18 inches from the plate at the glabella, the best results are obtained when the principal ray makes an angle of from twenty-three to twenty-eight degrees with the basal plane. I have therefore adopted twenty-five degrees as the standard angle for the principal ray, and the basal plane, or the standard principal angle. With this distance of tube and direction of ray, the shadow of the edge of the horizontal plate of the frontal bone, where it joins the wings of the sphenoid, appears as a transverse line passing across the orbit about one-half inch below the supra-orbital ridges. The appearance, in a symmetrical picture, of this shadow in the position mentioned is a fair indication that the principal angle is approximately correct. I regret to say that some of the plates I shall show here were made before the importance of this angle was apprecaited, and before we had accurate means for adjusting it.

A few degrees variation from this standard direction is unimportant, but accuracy and uniformity are desirable. In order to obtain a fair degree of accuracy, I have arranged my tube with an indicator of transparent celluloid which locates the principal ray, and a scale graduated in degrees, which shows the angle between the principal ray and the perpendicular.

I have also a little instrument which measures approximately the angle of the basal plane with the perpendicular. This device carries a conical plug, which fits into the external auricular orifice, and a ruled celluloid strip which can be adjusted so that the ruled line passes over the center of the glabella and therefore lies in the basal plane. A scale, graduated in degrees, to which is attached a spirit level, may be turned until the zero point on the scale is perpendicular. In this position, one of the little pointers indicates the angle of the basal plane with the perpendicular, and the second pointer, placed twenty-five degrees away, indicates on the scale, the correct angle for adjusting the tube holder.

With the Albers-Schonberg apparatus, the same result may be obtained approximately by placing the tubular diaphragm in such a direction that its axis lies in the plane passing through the glabella, and about three-quarters of



Two photographs of a model constructed for showing the effects of changing the position of the tube with reference to the skull. The direction of the rays in mesial plane is shown by stretched elastic cords passing from a point representing the target of tube to a bar placed in front of face and representing a line in the middle of plate. The principal ray is represented by a cord of lighter color than the others and the basal plane is shown by a strip of tape fastened to the skull at its base.

In A, the principal angle is approximately 25°, and it will be seen that the rays passing through frontal sinus are not obstructed by irregular parts of the base of skull.

In B, the principal angle is too small (about 5°). In this position the shadows of parts of base of skull would be superimposed upon those of the sinuses.

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an inch below the parietal eminences on each side. It is understood, of course, that in making the antero-posterior projection the principal ray, or the axis of the Albers-Schonberg cylinder lies in the median plane of the body.

The radiograph of the head in the transverse direction, is comparatively easy to make, and is of little importance. It gives an idea of the depth of the frontal sinus, and a knowledge of this depth is sometimes useful in interpreting the shadows on a so-called "front view" plate. The outline of the sphenoidal cells may be shown in the lateral projection, but I am told that this is of little use to the surgeon. I therefore make this plate with especial reference to the frontal sinus. The plate is supported parallel to the median plane, and the ray passing through the center of the glabella is perpendicular to the plate. The sphenoidal cells may be best shown by passing the perpendicular ray through the middle of the line joining the external auricular orifice, and the external angular process.

It is well known that photographic prints of X-ray plates fail to show the detail of the original negative. This is especially true of plates of the skull. In these sinus plates, the print is particularly disappointing, and we rely solely up the negative. Contact copies on glass are difficult to make, and they seldom show as much as the original negative.

The examination of these negatives is facilitated by having a dark mat around the part of the picture we want to see. I therefore make these radiographs on plates eight by ten inches, and have devised a method of giving them a very dense black border, which is as follows: After the exposure is made, I cover the plate with a piece of cardboard the exact size of the plate holder. This cardboard carries at its center a sheet of lead of sufficient size to cover the useful part of the picture, and carries also the words "right" and "left" with the plate number in lead letters and figures. An exposure to X-ray of about three seconds through this cardboard and lead, produces in the developed plate a dense black border around the useful part of the picture, which has been protected by the lead plate, and leaves the indicating words and figures on the plate in the proper position. The appearance of the black border in the developing tray is found to assist materially in examining the plate by ruby light to determine the stage of development.

DISCUSSION ON DR. CALDWELL'S PAPER.

DR. GEORGE E. PFAHLER, Philadelphia:—The society is indebted to Dr. Caldwell for this excellent presentation of this subject. This also gives me an opportunity to mention another point. That part of the profession that is interested in the study of frontal sinuses was pleased at the light that the X-ray threw on the study of these sinuses about a year ago and we wondered who really did the work. Now we learn that this beautiful work was done by Dr. Caldwell.

Some clinicians will accept such hard labor and beautiful work without giving credit to the man who did the work. We should insist on receiving at least half the credit when we do all the work. I shall insist when doing this work in being a joint author of the paper, instead of not being mentioned. I read one of Dr. Coakley's papers about a year and a half ago, but found no mention made of Dr. Caldwell, although he did all the X-ray work.

About six weeks ago in a case of alopecia I wanted to examine the progress I was making in the treatment of a round cell sarcoma of the frontal sinus. I made an exposure of thirty seconds, although usually I make it in ten or twenty-five seconds; but in this instance I wanted to be sure of my results. About four weeks later the patient lost the hair exactly corresponding to the outline of my diaphragm. This emphasizes the importance of short exposures and the use of the filter. I treated that patient for nearly three years and was one of the first on whom I used the leather filter and she first recognized the absence of a burning sensation when the filter had been used. I believe that if I had used a filter in the instance mentioned that it would have saved that patient's hair.

As to the angle. When Dr. Caldwell read his paper, I thought that he was making the angle in the opposite direction as I have been doing. Albers-Schoenberg makes his plates with the angle in the opposite direction from the base of the skull. Albers-Schoenberg passes his rays through a line drawn through the glabella and lower portion of the mastoid process which will throw the rays below the skull, and it seems to me that that should give us at least a better view of the antrum of Highmore. It may not give quite as good a view of the frontal sinus, but I am quite sure that it will give you something, and the rays pass through the spinal column very near the second vertebrae and those rays are so much diverted by the time they reach the plate that they do not obscure the shadows of the frontal sinus.

DR. ALFRED L. GRAY, Richmond, Va:—I want Dr. Caldwell, in closing his discussion, to tell us how he can determine whether the cavity is filled with pus or whether the shallow is caused by an abnormal thickening of the bone. It has been my experience in observations of frontal sinuses that very often we find one plate considerably thicker than it is on the other side. I would like to know how Dr. Caldwell determines that point.

DR. PERCY BROWN, Boston:—Dr. Caldwell spoke of using a hard tube, and yet not one that is too hard. I should like to ask him if he can give us approximately, in terms of Walter, the hardness of the tube he uses in the ordinary skiagraphic procedure.

DR. LEWIS GREGORY COLE, New York City:—I think that the paper which Dr. Caldwell presented, especially the matter of the angle, is very fine. I have done some of this work and I have followed in a way the same angle Dr. Caldwell has, that is, having the ray come through in the same direction he does, although I have not measured it with the same accuracy.

I would like to ask him with what degree of certainty he can make a negative or a positive diagnosis as to the presence of pus in the cells. In some of the plates shown there is no question as to the diagnosis, but in the borderline plates, I wish he would tell us how he makes his diagnosis.

DR. CALDWELL, closing the discussion:—With reference to Dr. Pfahler's criticism, I think he has overlooked the fact that the author of the papers he mentions has not claimed that he made the radiographs himself, but has given full credit to the Roentgenologist. I fear that Dr. Pfahler is a little overgenerous to the X-ray worker.

We are indebted to the clinician for material for suggestions and for his demonstration of the usefulness of the X-ray in this comparatively new field.

I have never tried to make a radiograph with the tube placed so that the rays which cast the shadow of the frontal sinus must first pass through the cervical vertebrae and the base of the skull. The shadows of these irregular bones superimposed upon that of the frontal sinus would in my judgment, be far more objectionable than those produced by the comparatively smooth and regular bones of the skull with the direction of rays I have used.

When the radiograph shows that there is something in the sinus which casts more of a shadow than is normal we assume that this is fluid. We have not been deceived by thickened bone on one side. I fancy that the shadow due to thickening of the bone would not be sharply limited by the septa as is the case with those due to cavities filled with pus.

As to the accuracy of this work I cannot tell. I imagine we have about the same degree of accuracy that we have in raying for kidney stones.

I do not use any of the well-known penetration gauges for the reason that the tubes may change so quickly during the exposure that a measurement made before or after will not be reliable. I gauge the penetration by two things. By the appearance of the fluoroscopic screen during the exposure and by the reading of the milliamperemeter in series with the tube. With a certain interrupter and coil, with the rheostat resistance all out, a reading of ten milliamperes shows that the penetration of the tube is about high enough. This method of gauging the penetration has proven quite satisfactory in my work.

THE INDUCTION COIL.
A STUDY OF THE CAUSES OF INVERSE DISCHARGE.

H. CLYDE SNOOK, A.B., A.M., Philadelphia, Pa.

The great problem in the use of an induction coil for X-ray work is the finding of some means for preventing the current from passing through the tube in the wrong direction.

This current which tends to pass the wrong way through the tube has come to be known as the "inverse discharge."

Its baneful effects are well known, but its causes have not been so well understood.

Since they are the standard type in universal use, let us consider coils of the Ruhmkorff type when used with the different kinds of interrupters. Upon examining them we find that the voltage of the "inverse discharge" varies greatly, being higher the longer the spark length of the coil, and varying in coils of different makes from 5 to 20 per cent of the total spark length of the coil.

(S. No. 1.) The current curve in the primary of a coil operated with an electrolytic interrupter, when the primary has no secondary around it looks like this; provided the primary has a certain self induction and the interrupter a definite adjustment. The curve shows the current rising against the counter E. M. F. of self-induction and reaching a steady limit set by the resistance before it is finally interrupted and suddenly brought to zero. (ind.) This is the "break" and is the time when the high voltage would be induced in the secondary if it were associated with the primary. During the rise of the current against the self-induction we have the "make" and it is at this time that the secondary would have induced in it a voltage of potential opposite in sign to that induced at "break;" and if it produced current in the tube it would be our enemy, the "inverse."

(S. No. 2) If we increase the voltage used with our primary coil and electrolytic interrupter, or if we decrease the self-induction of the primary—leaving the interrupter at the same adjustment—we get a curve something like this. The frequency of the interruptions increases and the current rises more abruptly at the "make." The voltage

Read by invitation before the 7th Annual meeting of the American Roentgen Ray Society at Niagara Falls, N. Y., August 29 to 31, 1906.

induced in the secondary is a function of the steepness of the current curves of the primary. It is thus seen that the voltage of the "inverse" is increased by decreasing the self-induction of the primary or by increasing the primary voltage on which the coil is operated.

(S. No. 3) If we use a large value of inductance in the primary the curve may not be flat on top, but may be like this. We notice that the curve is not so steep at either "make" or "break" as when we used lower values of inductance. This curve would indicate a very greatly reduced inverse voltage and a somewhat reduced direct one.

(S. No. 4) If a mechanical interrupter of some kind be used, such as a platinum hammer break, or a mercury dip, or a mercury jet interrupter, a condenser must be bridged across the break to minimize the arcing at the contacts and to permit of a sufficiently sudden interruption of the current. Otherwise the coil will operate very indiffer ently and the contacts will be rapidly burned up by the arcing. A primary—without a secondary around it—operated by a mechanical interrupter may give a curve like this No. 4 We have a few saw teeth in this curve. (ind.) This horizontal line we remember, represents the progression of time from left to right. Above this line current is positive, below it, negative. At the time of "break" we find the usual sudden fall of current immediately followed by three saw teeth below the line and three above it. This is the oscillation of the condenser which is bridged across the contacts of the interrupter. Since the condenser is charged by the interruption of the circuit, it discharges back through the primary coil and line, producing a damped train of electrical oscillations, which in this case died down to zero in about 2½ complete cycles.

The number of oscillations per second under conditions such as these is

$$n=\tfrac{1}{2}\pi\sqrt{1/LC-R^2/4L^2}$$

where L is the self-induction in the circuit, C is the condenser capacity, and R is the resistance. If R is so small that $R^2/4L^2$ can be neglected in comparison with $1/LC$, then the frequency

$$n=\tfrac{1}{2}\pi\sqrt{LC}$$

In this particular curve the frequency of this oscillation is approximately 800 cycles per second.

(S. No. 5) If we take a somewhat large value of inductance, or of capacity, or of both, as in this curve No. 5, when all other conditions are maintained as they were

in curve No. 4, we find that at "make" the self-induction keeps the curve from being steep, that at break the current does not fall so abruptly to zero, that the period of oscillation of the condenser has very greatly increased, and that the amplitude of the condenser oscillations is quite large indeed.

(S. No. 6) Should we use still larger values of inductance and capacity we should get a curve in which a trifle over 2½ oscillations of the condenser occupy the entire time of no contact at the interrupter and the amplitude is still greater.

(S. No. 7) Curve No. 7 is of current in a primary of high self-induction, no secondary around the primary, but with the condenser oscillations damped to such a degree that a single half period can scarcely be distinguished.

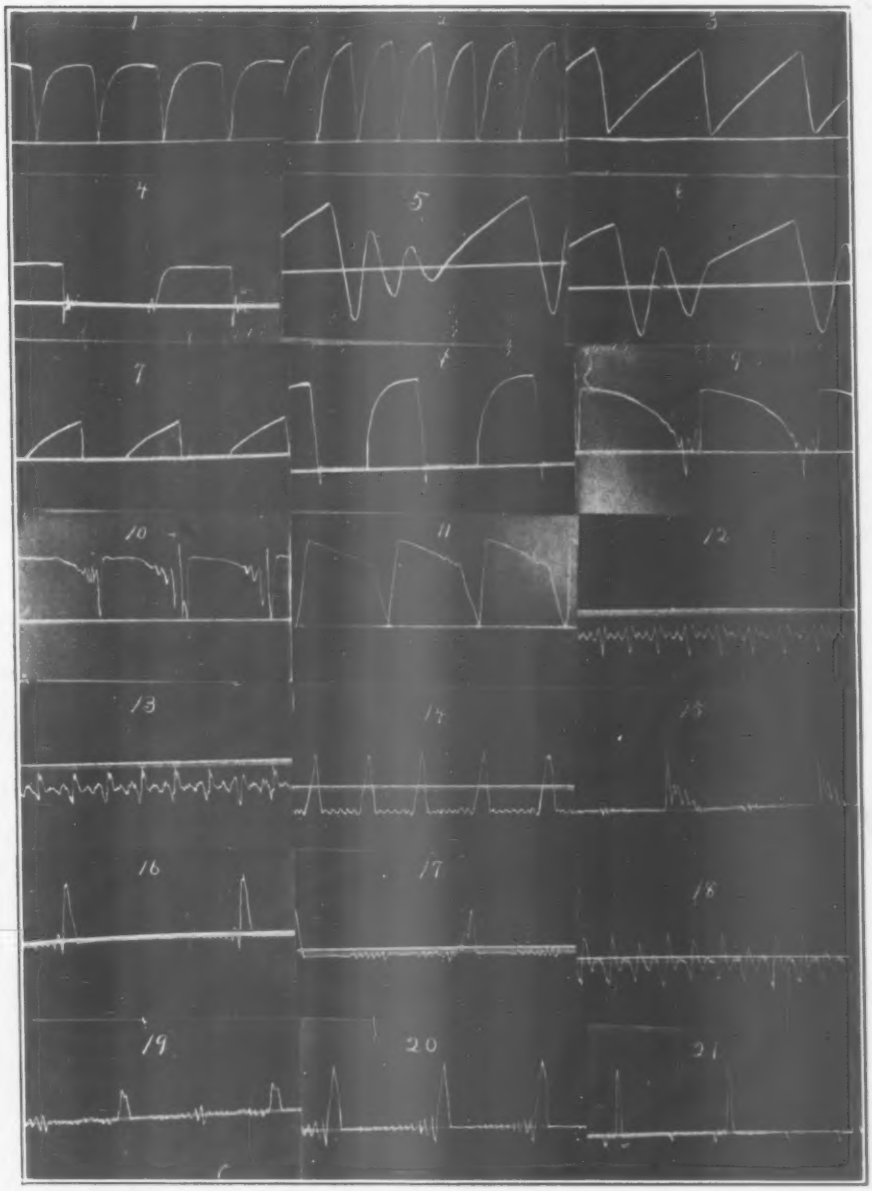
(S. No. 8) Curve No. 8 was taken under conditions exactly similar to No. 7 excepting that less inductance was used. The expected steepness of the curve at "make" is to be noted.

(S. No. 9) If we now put a secondary around our primary, and again using the electrolytic interrupter, we operate the apparatus so that we have a high voltage induced in the secondary winding, but with no sparking at the secondary terminals, we will obtain a current curve in the primary somewhat like this curve No. 9. This is a more complicated curve than we obtained under exactly similar conditions without a secondary being associated with the primary. The new wiggles in the curve may be explained in brief as being due to brush discharges from the terminals of the secondary and the oscillation of the secondary as an open circuited resonator, mainly the latter.

(S. No. 10) If we permit sparking at the secondary terminals—the bright snappy kind of a spark—but maintain all other conditions as in curve No. 9, we get this curve No. 10. Here we have the saw teeth due to the oscillations of the secondary, but the decrease of the self-induction of the primary caused by the sparking is very marked.

(S. No. 11) By operating the coil at its full output and producing a fat, fuzzy spark between the terminals we obtain a current curve for the primary as No. 11.

When a mercury jet or platinum break is used the current curve in the primary is very complicated if sparking is permitted to take place at the terminals of the secondary or if an X-ray tube is excited by the coil. The



OSCILLOGRAPHIC TRACINGS TO ILLUSTRATE MR. SNOOKS PAPER
Note that in Nos. 1 to 8 time advances from left to right; in 9 to 14 from right to left; in 15 from left to right and in 16 to 21 from right to left.

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discussion of a number of such curves which the speaker has taken from different coils is beyond the scope of this paper and are therefore omitted.

(So. No. 12) Upon investigating the currents which flow in the secondary coil at its middle, we discover that even without sparking at the terminals, or the operation of a tube, that current is flowing in the secondary at its middle. This is a necessary condition from the oscillations occurring in the winding of the secondary, which were noted before. This curve, No. 12, is of this oscillating current when the electrolytic interrupter is used with a low value of inductance in the primary.

(S. No. 13) Curve No. 13 was taken under the same conditions as No. 12, with the exception that a bright snappy spark was occurring at the secondary terminals. The effect of the sparking is seen in the extra tiny wiggles and the slight change in contour of the larger waves. (ind.) Here is one place at the time of one "break" of the interrupter where the spark failed to occur at the secondary terminals. It is seen that the tiny wiggles are absent and the wave shape is exactly like that of the waves of the last curve.

(S. No. 14) With a flaming spark at the secondary and a high value of inductance in the primary the electrolytic interrupter will give a wave like No. 14 at the middle of the secondary. (ind.) This high wave peak is the direct current or current going in the direction of that induced in the secondary at "break." (ind.) While these little wiggles are again the oscillations of the secondary, but they are not so great in amplitude as those of the two preceding curves.

(S. No. 15) No. 15 is the current curve at the middle of the secondary when bright sparking takes place at the secondary terminals and the coil is operated by a platinum hammer break with a medium inductance of the primary and a medium condenser value. Current above the zero line is "direct"—below it, "inverse." This shows very little "inverse," and since it is taken at the middle of the secondary, it does not necessarily indicate "inverse" in the spark.

(So. No. 16) No. 16 is similar to No. 15, but the electrolytic interrupter is used. Current is passing through a high value of inductance is in the primary. The saw teeth following the peaks of direct current indicate very clearly the prolonged oscillation of the secondary.

(S. No. 17) No. 17 is identical with No. 15, but a harder tube is used and the current does not rise to so high a value because of the increased tube resistance. The condenser oscillations are seen to serrate the wave form of the current at break, and when the latter has fallen to a low enough value they produce an "inverse" current.

(S. No. 18) With a low value of inductance, a high frequency of interruption, a soft tube and the electrolytic interrupter, the current curve at the middle of the secondary is as in No. 18. There is a great deal of inverse as is seen by the waves below the zero line.

(S. No. 19) No. 19 is current in the secondary at its middle when a mechanical interrupter, quite high primary inductance and a large condenser are used with five milliamperes in a soft tube. The inverse due to the condenser oscillations is almost absent. The secondary oscillations are readily seen at both "make" and "break," while the longer wave of the condenser oscillation lies between "make" and "break" with its smooth curve ruffled by the secondary oscillations.

(S. No. 20) No. 20 is exactly the same as No. 19, excepting that the electrolytic interrupter is used.

(S. No. 21) We have here in No. 21 the curve of current not at the middle of the secondary as in the last few previous curves, but the curve of current which actually passes through the tube. With a very low value of inductance, a large condenser and a mechanical type of interrupter an inverse discharge was produced which passed through a fairly hard tube along with the direct current. Taking as land marks the tall peaks of "direct" current which come at "break," we notice the inverse current at "make" and also at one of the semi-oscillations of the condenser. This inverse due to the condenser oscillations occurred at the first semi-oscillation which produced "inverse" voltage, and it is to be noted that the succeeding condenser oscillations were unable to produce enough potential to equal the ionization potential of the tube. The abruptness with which the current in the tube begins and ends at this semi-oscillation of the condenser, in spite of the fact that the current through the primary due to the condenser oscillation is a damped sine wave, proves the existence of a very definite ionization potential for the tube. And it shows also that although the ionization potential may not be the same for the continuation of the current as for the establishment of it, yet the potential necessary for the continuation of the current is just as definite in value as that

for its establishment. The oscillation due to the capacity of the tube electrodes, the wires leading to it and the secondary coil are seen in small waves between the peaks of direct and the inverse caused by the condenser.

(S. No. 22) In No. 22 we have everything the same as in No. 21 but that the condenser and inductance have been adjusted so as to prevent the passage of the "inverse." The curve is entirely above the line. This is as it should be and is often difficult to obtain.

(S. No. 23) With a very large value of inverse at "make," when a soft tube and low inductance is used, we obtain a curve for the tube current as in No. 23. A slight peak of inverse from condenser oscillation can be seen in this curve.

(S. No. 24) No. 24 gives us the curve of current in a tube when there is no inverse present and the coil is being operated properly with an electrolytic interrupter.

The study of these curves has revealed several causes of "inverse discharges." Our old idea that "inverse" tends to form at "make" with all types of interrupters is confirmed as being correct so far as it goes. But we find additional sources of its formation. Two principal additional sources are the oscillation of the condenser bridged across the break, and the oscillation of the secondary itself as an open circuited Hertz resonator. A third source of minor importance is the oscillations due to the capacity of the electrodes of the tube and the wires which lead from the coil to the tube.

To minimize the formation of inverse due to the "make" the coil maker must use generous proportions and large quantities of material.

It is difficult to strike a balance between the "inverse" and the cost, but even when no limit is placed to the cost the "inverse" voltage is never made zero—it is only reduced—and there is still danger of its passing through the tube.

If coils did not deliver any inverse voltage there never would arise any question regarding the "number of layers on the primary" and there would be no need of selecting the proper inductance value for a given degree of tube vacuum.

It seldom occurs—very seldom occurs—that the tubes in common use will permit the passage through them of current due to the oscillation of the wires which lead from the coil to the tube; but in some coils the oscillations of the secondary very frequently get into the tube.

In addition to proper coil construction which will reduce the inverse voltage, there may be used in series with the tube resistances of various kinds which will minimize the inverse current. Among these are many kinds of spark gaps and valve tubes. The speaker has studied these very carefully and has found that a good valve tube is the most efficient of these devices when its vacuum is maintained at the correct point. It has the serious objection that this maintenance of the correct vacuum is difficult and troublesome—especially when heavy and long duty is demanded of it. A plain series spark gap is the simplest and easiest thing to use. It is better than most so-called valve tubes, but is not nearly so efficient as a really good valve tube. The great advantage which a good valve tube has over the series spark gap is that the tube offers very little resistance to the direct discharge and a large resistance to the "inverse," while the series spark gap offers as much resistance to one as to the other.

It is beyond the purpose of this paper to discuss the types of interrupters which may be used successfully with a Ruhmkorff coil, except to note that all have objectionable features of cost, construction and maintenance, and that all without exception are impotent in suppressing the "inverse" voltage. All platinum contact breaks require filing and occasional renewal of the platinums, while once in a great while a spring is broken.

All electrolytic interrupters are mussy and those which employ sulphuric acid as the electrolyte emit a corrosive acid spray destructive to furniture, clothes, carpets and floors.

All mercury interrupters require periodical cleaning because of the churning up of the mercury into a black mud.

The mercury turbine jet interrupter gives trouble when its contact segments wear away by the arcing at "break" and the amalgamation with the mercury.

The curves which have been shown are a part of a number which have been taken by the speaker from coils operated by the three types of interrupters—platinum, mercury and electrolytic.

The recording apparatus was a Duddell high frequency oscillograph. Other work, the logical sequel, has been done by the speaker and a record of it must be reserved for another time.

The investigations which are the basis of this communication were carried out by the speaker in the Randal Morgan Laboratory of Physics of the University of Pennsylvania under Dr. Arthur W. Goodspeed, a member and former president of this society, and to him at this time the speaker desires to express his gratitude and appreciation for the facilities placed at his disposal.

DISCUSSION ON MR. SNOOK'S PAPER.

DR. REGINALD MORTON, London, England:—I wish to congratulate Mr. Snook on the excellent work he has done. This is of great importance to us in England where we have been suffering as much from inverse discharges as you have. I thought also that I might bring to your notice a new instrument in this connection. It was first described about a year ago in a German paper and is called a vacuum vacillograph. As you may know the Dale vacillograph costs from five hundred to a thousand dollars, and unless you are trained in its use, you must have some one run it for you; but the little instrument to which I refer is absolutely correct and accurate and will give you a true rendering of any current you can get through it.

The instrument consists of a plain vacuum tube cylinder two inches in diameter and fourteen inches long. It has two nickel electrodes which nearly meet in the center. As soon as the vacuum is about five or six millimeters of mercury (this is rather critical and must be gotten right, but it never changes afterward) as soon as the current passes through this, it must be up to five hundred or thereabouts, you can put it in series with an X-ray tube, and it shows exactly what is passing through the circuit. Whichever electrode happens to be negative becomes covered with a purple coating, which, if examined carefully looks like a glove or stocking being pulled on. That is practically stationary, but if you examine it with a rotating mirror the whole matter becomes opened up. You will get true sign curves and instead of coming out like a thin line you get a cone showing a solid block of violet light. By running the mirror with a motor you can photograph the image with ease. There is a band of bright light between the electrodes which comes out white and bright, and on the photographic film makes a white line, which gives the zero line. Putting it in series with the X-ray tube shows that the impulses passing through the tube are exceedingly short. There is nothing in all my work with this instrument that impressed me more than that. They are exceptionally short if you are using a main current, fifty cycles per second, by turning the mirror rapidly the width of the base line will be three times its height. You can make long fat line or you can get short ones. When you try the current going through the X-ray tube you will find that no matter how fast you spin the mirror you cannot lengthen the wave out any perceptible degree, and it is as nearly momentary as anything can be imagined to be.

I imagine that the spots which Mr. Snook showed are due to some error. The instrument I mentioned can be bought for from five to fifteen shillings, and I strongly advise you all to obtain one and use it. It will give you an added interest in the physical side of your work.

DR. WELLS, St. Louis, Mo:—I wish Mr. Snook would tell us something about the selection of a proper series gap. There is certainly a difference in the performance of the ordinary air gap and the point and plate multiple gap. I can appreciate this excellent paper only in its essentially practical aspect, and this is one point suggested during its reading. He said nothing about it. There is a difference in the various series gaps that have been provided with the various equipments of different makers, especially with reference to the width of the disc in the point and disc rectifying multiple gap.

DR. W. S. LAWRENCE, Memphis:—Last winter I worked quite awhile on the spark gap proposition, and I thought I had devised something that was new with point and disc. The one I devised works excellently, and I do not think that Mr. Snook's passing word is sufficient on this point.

I notice that a spark gap constructed by one of the makers is all together on a wrong principle, a point and disc spark gap it is, but the points are too close to the discs. The advantage of the disc and point spark gap is this: when the disc is positive the current will tend to leap from its outer edge to the nearest point; when the point is positive, the current will leap from the point to the nearest part of the disc which is its center opposite the point. Now the distance between point and disc can be so arranged as to make the path of the current when the *disc* is positive of maximum length and the path that the current will take when the *point* is positive of minimum length. This distance is found by trial to be one-half the diameter of the disc. With this distance the resistance of the two paths offered to the current is about in the ratio of 5 to 7. For example, say that the diameter of each disc is ten millimeters. In such a series the points must be five millimeters from center of discs to get the maximum efficiency. Then when the current is passing in the direction from point to disc, it will have this distance of five millimeters to jump. If you reverse it, the current will not jump from the center of the disc to the point, but from the edge of the disc to the point, and it will have a greater distance to pass through. The square of five being twenty-five, and the diameter of the disc being ten, will make from its center out to its circumference five, and the square of this twenty-five; adding that together makes fifty, and taking the square of that will give the square root of the hypothenuse of a right angled triangle, which is about seven—seven times seven being forty-nine—so that the distance the spark must jump will be seven millimeters. And that is where the advantage comes in. It has only five millimeters to jump in the one case and seven millimeters in the other. If you have a series often, you get seventy millimeters which it must jump in one case when going in an inverse direction, and only fifty millimeters of air to jump when it is going in direct direction. The sides of similar triangles being in proportion, this ratio holds good for any size disc.

That is the principle on which I constructed my series spark gap, and it seems to work very well. If you put the point very close to the disc, the current will not jump from the edge of the disc to the point, but from center to point, and the distance is about the same, no matter which direction the current is going; while if the point is placed at greater than radial distance from the disc, the length of the path traversed by the direct current is increased more rapidly than the length of that traversed by the inverse current.

DR. ROME V. WAGNER, Chicago:—I think that the use of these vacuum tubes in series with an X-ray tube is quite an advantage to

those working with the coil apparatus. There is unquestionably a very little resistance added in circuit with the tube, and you can select the proper spark gap. As soon as you find that there is inverse current, you can increase or decrease the spark as desired to prevent its action.

The objection that the spark gap offers resistance to the current in right direction as well as in wrong direction is not a great one, especially if you have a coil giving a longer spark gap than is required to overcome the resistance of the tube. When a tube backs up over six inches it is too high to be operated safely. The vacuum of the tube should be lower than this or it is liable to be punctured. I think that in coil construction the great feature is the interrupter.

I have been experimenting for some time trying to overcome the objectionable features of the interrupter and the trouble and annoyance occasioned by the care of the interrupter. I worked a number of coils by interrupting the magnetic circuit instead of the electrical circuit. After I got this about perfected and had told a number of X-ray workers that I expected to manufacture a coil of that kind, I discovered a simpler and more effective method to do away with the use of the interrupter. The way I wind the primary of the coil is with two windings. (It is difficult to describe the coil without a blackboard or drawings.)

The current is generated in the secondary of an induction coil from the magnetic action of the iron core. If the core is magnetized from a primary operated with the direct current, every time the current is turned on the core magnetizes and generates an impulse by induction in the secondary in one direction, but when the current is turned off the core demagnetizes and generates an impulse in the secondary in opposite direction. Current generated by the demagnetization of the iron core is very much stronger than by the magnetization of the iron core. Current generated by the magnetization of the iron core is called the inverse current. The current is turned on and turned off or interrupted through the primary winding from 1,000 to 3,000 or 4,000 times a minute by the ordinary interrupter. Every time the current is turned off the arc or spark formed at the breaking of the contracts produces waste which requires repeated adjusting and replenishing.

To overcome these objections I have devised a means by which the current is reversed through a part of the turns in the primary winding. In order to do this the core is wound with two wires instead of one so that the number of turns in the primary may be equally divided. Current is allowed to pass constantly through one-half of the turns and is alternated through the other half of the turns. When the current is passing through all of the turns in the same direction we have the full magnetizing force and when the current is passing in the opposite direction or reverse direction through one-half of the turns there is no magnetizing force and the result is the same as though the current were turned off entirely, thus we do not break the current, but merely switch it back and forth through one-half the number of turns on the primary.

A rotary pole changer for reversing the current through one-half the number of turns on the primary requires but little, if any attention and as the force magnetizing the core is cut off much quicker than a current of 3 to 5 amperes may be broken the efficiency of the coil is increased and we get away from so much of the condenser action that produces inverse current.

MR. H. CLYDE SNOOK, closing the discussion:—It gave me great pleasure to hear what Dr. Morton had to say in connection with this matter. Referring to the question of the periodic time of the system I was using, I wish to assure you that I calibrated it at the frequencies that we used on the curves you saw and that at the frequencies in those curves the system was not oscillatory and its period was much less than any recorded in the curves.

The second speaker requested a discussion of the correct value of the simple series spark gap. Dr. Wagner, in the first part of his criticism, answered the question as to how to adjust the spark gap by means of one particular method, namely the use of the vacuum tube or oscillatome. I would say that practically you are limited in increasing the length of the series spark gap or gaps which you have in series with the X-ray tube, because of the fact that your coil will not give a long enough direct spark or deliver enough current to the tube. When you cannot increase the spark gap sufficiently to equal this inverse voltage, it is then impossible to prevent the passage of the "inverse" by use of the spark gap.

Resort should be had then to other methods. It is best always to use all the means at our disposal. Use as high a value of self-induction in the primary of the coil as you can and still get sufficient current in tube so that the inverse produced by "make" will be at a minimum to begin with, and then the other remedies can be applied.

As for the point and disc. It is hardly proper for me to discuss that under the present circumstances, but I will say that when the point and disc is properly constructed, and used, that with small values of current passing through the point and disc multiple series spark gap, that then it is of value. But when the current reaches an amperage of perhaps two and a half milliamperes, then the point and disc is not superior to the multiple simple series spark gap. The reason for this may be found in the ionization of the air in the vicinity of the electrodes forming the point and disc, thus rendering nugatory the effect of the difference of density of potential on the two electrodes which causes the primary effect expected.

As for Dr. Wagner's scheme as he has explained it, unless it includes something radically more and different than he describes, the coil which he proposes will produce inverse voltage.

PERSONAL TECHNIQUE IN THE TREATMENT OF EPITHELIOMA.

DR. KENNON DUNHAM, Cincinnati.

The fact that properly selected and properly treated epithelioma respond better to irradiation than to any other therapeutic agent is beyond discussion among men who have carefully studied the subject.

This statement might lead some careless reader to suppose that this opinion was born of one long and uninterrupted series of successful cases. It is my intention to state the opposite idea.

The present assurance of success with which I undertake the treatment of these cases is due to the fact that I feel it is possible to master the two qualifying adverbs in the first sentence, properly selected, and properly treated.

Selection of Cases—If the neoplasm is located on the face the X-rays pure and simple should have the first consideration, because nothing else gives such perfect cosmetic results. There has been one exception to this in my practice—the lower lip. I do not understand why (it may be lymphatic circulation) but I have had no epithelioma of the lower lip, which extend over the margin of mucous membrane from the skin, give me anything but trouble, until I operate most radically, dissecting out the lymphatics in the neck.

The cases which have given the greatest satisfaction and which respond the most readily to the rays have been those of mushroom growth and which did not extend far into the connective tissue, and those with heavy crusts and central ulcer which look like broken down warts that have gone to seed and finally rotted. Rodent ulcer, although slow to respond, gives wonderfully satisfactory results. There is another form which has given me much trouble. The thin squamous epithelioma which spread without piling up or eating into the epidermis and have a very vascular base. They occur in patients who have very fair and delicate skin. These cases will burn easily and although they can be kept practically well if carefully watched, and treated when necessary, they do not give the soft healthy connective tissue scar which we desire.

Read by invitation before the 7th Annual meeting of the American Roentgen Ray Society at Niagara Falls, N. Y., August 29 to 31, 1906.

There is no form of epithelioma except the lip that I have seen which has not been greatly improved by the rays alone. The recurrences usually occur in those cases which have grown far into the connective tissue and have involved the lymphatics. If you attack such a case as this through the X-rays alone you must know what you are about or you will make worse than a failure. The tumor will break down and be disseminated through the lymphatics and you had better not have tried. The cases of large epithelioma which appear upon the extremities or on the body and which have been long neglected because they are not conspicuous and have given little or no personal inconare dangerous to undertake with X-rays alone unless the patient fully understands the chances of spreading.

There are many instances in old people where the piling up of the epithelioma has not progressed so that it is ordinarily termed malignant. These are so easily removed by a few exposures that it should always be done, because malignancy frequently occurs later.

Treatment.—The statement that the X-rays break down, scatter the malignant cells through the body and often do more harm than good, is true, and is due to the very common procedure followed by many physicians of treating the case with any tube which is most convenient, high or low, near or far away from the lesion and letting it run regardless of consequences. Very much like kill or cure. The spreading is possibly due to the stimulating effect of small dosage. This is done by the sort of doctor. usually a dermatological specialist, who explains that all this talk of technique is just a bluff. But you gentlemen know better.

The technique which I now follow in case of lip where the mucous membrane and skin are involved is radical operation with careful dissection of all the lymphatics draining the part, and irradiation both before (until operation can be prepared for) and afterward for at least two months. The tube used is one which will back five inches of spark, while the milliamp-meter reads .6 of a M. A. at a distance of eight inches; expose ten minutes every second or third day with a leather filter interposed.

This is continued for twenty to twenty-five treatments and then carefully watched as long as I can keep track of the patient.

The mushroom growths which do not appear to extend deeply into the connective tissue I have never known to recur or to need surgical assistance. They dry up or fall out, either as a whole or in part and leave a clean wound which under antiseptic precaution rapidly granulates, the connective tissue fills in a soft scar which is often almost imperceptible. Tube is placed as close as apparatus will permit, spark gap three inches M. A., meter reading one milliampere or a little over. Exposure fifteen minutes repeated every day until there is a slight sign of reaction. This is often much more severe two weeks after the last treatment, but gives excellent results. Number of treatments, three to twenty.

Warty growths with nuclear ulcer are treated in practically the same way as the above, and although a few more treatments are necessary (ten to thirty) the results are universally good. These cases I have never seen recur.

Rodent ulcer requires more time, more care and sometimes the assistance of electrolysis, as I will describe later, but gives universally good results.

The tube used is harder, 4½-in. spark gap is backed up, one M. A. of current used and the tube with leather filter is brought as close to the ulcer as practicable. Exposure ten to fifteen minutes as the tube will stand. By this I mean that sometimes my anode gets very hot when I discontinue treatment because I do not know what I am going to do with a red hot anode.

Squamous epitheliomata with engorged base in fair skinned people.—This class of cases, as I have said, has given me a great deal of trouble. I can prescribe no definite form of treatment here, for I have tried them all and only get a partial recovery, although the tendency to recur is not strong and they become much improved. I have used both the hard tubes and soft tubes, placed close and far away, with and without epilation, but do not know which has given the best results. Dr. Williams, of Boston, uses upon these cases a very powerful specimen of radium with much benefit. I have not tried it, but hope to.

When the growth occurs around the alæ of the nose or the canthus of the eye there is a tendency to recur. This is not always the case, but I am always on my guard.

Whenever there is a recurrence, and at times upon rodent ulcer, and upon large epitheliomata of the body or limbs, which have penetrated deeply, I advise the following procedure:

Use the galvanic current as follows: Having cocainized the tumor or having anaesthetized the patient, completely surround the tumor with galvanized needles and connect these with the positive pole of the battery. A large surface of the patient's arm or leg having been closely fitted with a large negative electrode you may slowly turn on the galvanic current 30 to 110 volts according to the anatomical relation of tumor and large nerve trunks and allow the milliamp-meter to gradually run up to 80 M. A.; rest here for five minutes and then gradually cut out the rheostat until you have clinical reasons for stopping or have reached 400 M. A. It should take thirty minutes for the current to reach this amount. Many advise greater currents, but this is sufficient.

By this procedure you have closed the lymphatics and blood vessels surrounding the tumor and if you have driven the needle under the tumor as you would a spade into the ground, you have closed up many which lie below the tumor. Thus not only is the danger lessened of metastasis, but a large part of the tumor sloughs out with little or no pain and thus relieves the economy of the necessity of absorbing a large amount of proteid poison. This operation is immediately followed by irradiation, the character of which is entirely dependent upon the location, size and character of the tumor.

I have never been able to try this upon cancer of the breast, but shall upon my first opportunity.

This procedure appeals to me, first, because it works; second, because it closes the lymphatics and blood vessels by electrolysis and the eschar of the positive needle, until healthy granulation can do the work better; third, it leaves the wound open for irradiation; fourth, it saves the patient the necessity of absorbing a lot of virulent organic poisons; fifth, because the X-rays are not asked to do more than can reasonably be expected of them.

I have not spoken of the protection for patient or operator, but have left it until the last, because nothing can be more important.

All healthy parts are protected in any way which is surely adequate, even to using 1-16 inch of lead. No patient is ever burned unless it is intentionally done.

All assistants working with me must protect themselves or get out.

Dr. Jacobi, of New York, before the American Medical Association last June, told of the wonderful success he has

had during the last fourteen years by the use of methyline blue in cases of cancer.

I have tried it since in my cases—even of epitheliomata. It seems to be of some value. I have not had enough experience to decide.

In conclusion I can only repeat my first sentence, that properly selected and properly treated epitheliomata respond better to irradiation than to any other procedure.

DISCUSSION ON DR. DUNHAM'S PAPER.

DR. ENNION G. WILLIAMS, Richmond, Va:—As to the use of radium in the treatment of small growths and in early recurrences, I have treated four or five recurrences about the size of a pea with radium, and in each instance the recurrence has disappeared promptly. I have also removed several warts.

DR. GEORGE E. PFAHLER, Philadelphia:—As to the statement made by Dr. Dunham that he believes that the rays disseminate the growth. If that it is true it is important for us to know it. We undoubtedly do more X-ray work in this society than is done by all other workers together, and, therefore, we probably are in a better position to study the results than is any one else. I would like to have all of the members discuss this point and give their opinion. Personally, I feel confident that I have never seen a case that gave me any reason to believe that the rays disseminate the growth. We know that the tendency of these growths is to disseminate. That may be due to the technic to which Dr. Dunham just called attention, but we must be careful in stating that the rays disseminate the growth unless we have the evidence to prove it. I wish Dr. Dunham would speak of that.

DR. WILLIAM H. DIFFENBACH, New York City:—At the clinics in Vienna last summer I noticed that the edges of these tumors are frozen with ethyl chlorid. The patient comes in for observation between radiations which are given, as a rule, in maximum doses instead of small repeated doses. The dead tissue is cleared away and generally ethyl chlorid is used for this purpose instead of the curette.

DR. WELLS, St. Louis, showed lantern slides to illustrate the limitations of the Roentgen ray in the treatment of cancer. Specimens of the infiltrating variety involving the cheek and lower lip were shown with end results shortly before death.

Many others of the more superficial sort were shown with end results, cured.

Dr. Wells stated it as his belief that in treating superficial epithelioma, the reaction of mild degree should be obtained as soon as possible and the patient then allowed to rest until the lesion passes through the evolution which usually follows the getting of this reaction. The work is thus done in successive stage until the final disappearance of the lesion.

DR. RUSSEL H. BOGGS, Pittsburg, Pa:—I agree with Dr. Pfahler that the X-ray does not cause a spreading of carcinomata. I have treated a large number of cases, but have never seen one where I thought that the ray had disseminated the tumor. I have seen patients who had never seen an X-ray machine where the cancer had

spread to the adjacent lymphatics and on postmortem the liver and almost all the internal organs were involved.

DR. WILLIAM S. NEWCOMET, Philadelphia:—I think that Dr. Dunham has not given enough attention to the character and kind of cancer. The history of cancer on the face is often a very long one, extending 15, 20 or even 30 years, but not so in cancer elsewhere or around the lip. I think that the character of the disease has a great deal to do with the results.

DR. STEVENS:—I have been attempting to measure the dosage of the X-rays as well as I could, using large doses and infrequent treatments, and I get better results. The long continued application of the X-ray in small doses, even if it is done by an expert Roentgenologist, is irrational. If you do not secure results with epitheliomas in a reasonably short time with reasonable exposures it is better to discontinue because we have sufficient evidence in X-ray workers themselves that the X-ray produces the very condition we are trying to cure.

DR. ANDREW P. BIDDLE, Detroit, Mich:—I want to go on record as saying that the X-ray therapeutist needs a great deal of education in dermatologic lesions. I have seen in our city a case of the initial lesion of syphilis treated for a parasitic growth. We have all of us seen cases of supposed epithelioma that were nothing else than syphillis treated by the X-ray. We, the dermatologists, want you, the Roentgenologists, to educate us how to use the machine properly, but we want you to recognize also the fact that education is needed in the other direction as well by him who would apply his machine to therapeutic uses.

DR. DUNHAM, closing the discussion:—There are only two points to which I wish to refer. The cases I reported were all diagnosed by dermatologists or surgeons. They send their cases to the clinic with a careful diagnosis. We only treat the cases for them. There is nothing that can be emphasized with more benefit than just the point made by Dr. Biddle, that we must not assume knowledge where we have it not.

I know that I did not discuss all the forms of epithelioma, but only attempted to give a few cases treated in a certain way. I did not intend to cover the whole field.

In regard to dosage if you will consider the doses of the X-ray employed by Belot and Beclaire in their clinics, comparing their massive dose with the average American massive dose, you will find that the small American and the very large French doses are much alike. There is about the same difference as between the French and American scale of measurement. My effort is to get my results as quickly as I can, and to do this I treat these patients every day or as fast as I can. Where I cannot get them every day, only once a week or once in two weeks, I use the massive doses. Otherwise I repeat the dose every day until I get a slight reaction and in ten days to three weeks you get a good burn.

The use of ethyl chlorid is a good suggestion. It is a mild way of getting results, and a much better one than the more radical method of curetting the tumor.

The matter of dissemination is a very important one. This subject was brought to my attention by a case brought before the Academy of Medicine in Cincinnati as an example of why the X-ray should not be used in the treatment of epithelioma. It was evidently a case where a very small tube had played on a very large epitheliona until there was very suddenly a large spreading of the tumor. You can

do harm as I have said by giving too small a dose. This is usually called a stimulating dose. It probably acts by stimulating the neoplasm to increased activity, but is not powerful enough to destroy it or to close up the lymphatics through which its cells are dissiminated. Therefore your technique must be bold and heavy doses are necessary. If you do not do this you will have trouble. I believe that that can be avoided by proper technic and to assist that technique I have used the needle just as I told you.

THE TREATMENT OF MALIGNANT DISEASES OF THE BLADDER THROUGH SUPRA-PUBIC INCISION WITH REPORT OF A CASE.

A. L. Gray, M. D., Richmond, Va.

Mr. President and Gentlemen of the Society:

In none of the literature at my command have I at any time seen reported, favorable results from the Roentgen ray treatment of malignant disease of the bladder.

This condition is certainly of sufficiently frequent occurrence to justify the belief that it must have been tried, in many cases, before the involvement was so extensive as to render these cases hopeless when the treatment was applied, had the growth been easily accessible.

The now well known fact that the curative effect of the light is diminished to a very great extent in its passage through the superficial tissues and the inability to apply this agent in these cases without the most efficient rays being filtered out before it reaches the diseased area, must be responsible for the lack of more favorable results.

The problem of a tube of such shape and size as to admit of its introduction into the bladder *per urethram* and the generation of the light within that organ, is one that has not been satisfactorily solved and seems, especially in the male, to offer insuperable difficulties. Cytoscopy has been recently perfected to such an extent that intravesical growths may now be readily discovered on the first appearance of significant signs and symptoms, and we may hope that the factor of extensive peri-vesical tissue involvement when the patient is referred to us, may be to a great degree eliminated.

Read by invitation before the 7th Annual Meeting of the American Roentgen Ray Society, at Niagara Falls, N. Y., August 29 to 31, 1906

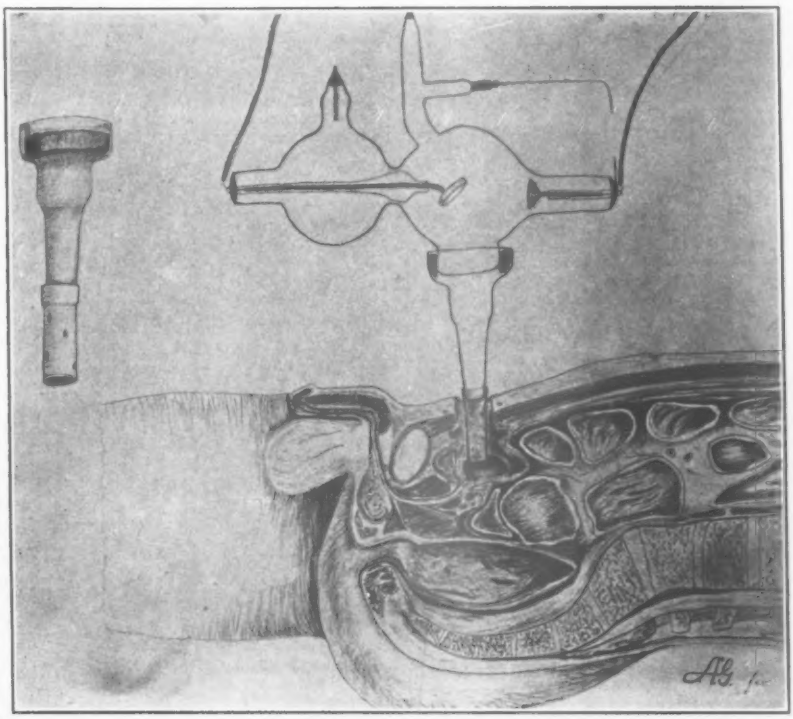
It seems to be the general experience of all Roentgen ray operators that the only cases in which we can, with any degree of certainty predict a cure, are those involving the skin and accessible mucous membranes, and doubtless the theory that the efficient rays are filtered out is the correct explanation. If the vesical mucous membrane be rendered accessible, we should naturally expect results similar to the treatment of like growths elsewhere.

However early a malignant tumor of the bladder be discovered, save at its very incipiency, surgical procedures cannot be expected to permanently eradicate the growth without the removal of so large a portion of the bladder wall that the patient, if he survive, must "eke out a miserable existence." It is especially desirable, therefore, that we devise some means whereby the tumor may be removed by the Roentgen rays.

The case which suggests this paper is as follows:

W., male, white, aet. 67; occupation, clergyman. Patient's trouble began in 1901 with dribbling after urination, which was the only evidence of disease at this time. Later the urine became muddy with a visible amount of blood present. This condition continued, and while there was only slight discomfort, not amounting to marked pain, he was beginning to be troubled with too frequent urination and consulted a specialist whose findings led to a diagnosis of cystitis and prostatitis. Since 1904 he had had several severe attacks of acute pain and tenesmus attended with the passage of dirty urine loaded with bloody pus, each attack lasting from one to two weeks and gradually subsiding.

November 1, 1905, patient presented himself to Dr. R. C. Bryan for treatment. He had been for some time wearing a rubber urinal on account of the almost constant dribbling present. Catheterization had never been necessary. Examination of his urine at this time confirmed the former diagnosis. A No. 27 F. sound passed easily; rectal examination, however, showed the prostate gland firm, free from tenderness, right side very slightly larger than the left. Repeated attempts at cystoscopic examination were unsuccessful on account of the hemorrhage present, though at different times silver nitrate and adrenalin irrigations were given. On account of persistent and alarming hematuria, supra-pubic cystotomy was advised and the operation performed January 5, 1906,—five years after the appearance of the first symptoms. A tumor was found "the size of a ten-year-old child's closed fist attached by a pedicle the size



To Illustrate Dr. Gray's Paper.

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of wrist of a child the same age." The growth was removed by severing the pedicle at its junction with the tumor. On account of profuse hemorrhage the entire bladder was packed with gauze. On microscopic examination the specimen proved to be squamous cell carcinoma.

One week after the operation, X-ray treatment was begun. The tube used was Piffard's protecting tube with the smaller sleeve attached. In order to administer the light directly upon the growth, a large, somewhat stiff, soft rubber drainage tube was cut just long enough to reach to the growth and admit of the projecting end being slipped over the free end of the sleeve. By this device, the patient being in the dorsal position, the supra-pubic wound was effectively and painlessly held patent. Fenestrae were made in the rubber tube to prevent the urine from rising within it and a wick of gauze, placed alongside the tube in the incision, drained off the urine as fast as it accumulated. While the diameter of the rubber tube was less than that of the stump to be treated, it was estimated that as the growth should shrink under the influence of the light, gradually more of its surface would come within the field and therefore, should the treatment prove beneficial, ultimately the entire stump would have been exposed to the light. Treatments of ten minutes each were given every other day. Once a week the finger was introduced to ascertain the existing condition. Each examination showed a gradual improvement and finally the complete disappearance of the entire pedicle after twenty-one treatments, leaving behind a soft linear ciccatrix.

Patient left for his home March 16, 1906. The supra-pubic wound closed about six weeks thereafter. He has remained free from any evidence of recurrence and is now actively engaged in his profession.

In the treatment of his case strict asepsis was observed, though perhaps in the majority of such cases, as was present here, more or less cystitis exists when they first come under observation.

While the situation of the tumor in this particular case seems especially favorable to this method of treatment, from the fact that the bladder is in a collapsed condition so long as the supra-pubic wound is not closed, almost any point on the bladder wall may be brought within the path the presence of a tube somewhat larger than the one attached to the sleeve of the X-rav tube, which also served

of the light. The incision was prevented from closing by for siphoning off the urine.

The happy results in this case seem to justify the operation of supra-pubic cystotomy at the earliest moment after a diagnosis of tumor of the bladder has been made, the removal of as much of the growth as can be done without serious injury to the bladder, and if malignancy be found, X-ray treatment should be begun as soon as the condition of the wound is such as to allow the tube to be introduced without producing too great pain or hemorrhage.

It is not at all improbable that urine may become itself radio-active as a result of the irradiation and exert an additional curative influence lasting, it may be, longer than the duration of the exposure.

Nothing short of clinical observation, however, can determine this until the peculiar character of radiant energy which produces the physiologic effect be ascertained.

DISCUSSION ON DR. GRAY'S PAPER.

DR. GEORGE C. JOHNSTON, Pittsburg, Pa:—The tube that Dr. Gray employed in this case was probably the only type of tube that could have been employed successfully. I at one time thought that those tubes were no good, but I found that in a small tube the lead glass is fairly safe for the patient, although not for the operator. But I want to call the attention of the society to one thing in connection with these tubes, and that is, that unless you make your exposure about one-half, you will get some surprises. These tubes are exceedingly active, therapeutically, and they have the enviable habit of producing a dermatitis of the second degree about a week before you expect it.

When using these obturators on the skin I use a small leather filter which does away with the dermatitis and does not interfere with the physiologic activity of the rays on the skin or the tissues beneath the skin.

The doctor's result is a brilliant one and I hope that he will report the ultimate outcome of the case at the next meeting, which is really what we want to know.

DR. WELLS, St. Louis, Mo:—This case is very similar from the standpoint of technic to those cases of carcinoma of the mouth and cervix, and it occurs to me to inquire whether Dr. Gray has used the Morton or Caldwell type of cavity tube. If they were practical and durable it would be an especially proper instrument to employ in such a case as this. I have never used them myself, but I would like to know what results may be obtained with them.

DR. GRAY, closing the discussion:—I can substantiate what Dr. Johnston said about the care and use of this particular tube. The first warning I received of anything of the kind was in a case of post-operative treatment of a case of carcinoma of the breast. I had been giving treatments for about two or three weeks without the slightest trace of reaction. The patient presented herself for the next treatment and I found a very pronounced burn of the second degree.

THE TUBE IN ROENTGEN THERAPY.

ENNION G. WILLIAMS, M. D., Richmond, Va.

It is not my purpose in this paper to give a complete discussion of the tube, but simply to discuss briefly those points that have have appeared to me to be of the most practical value in therapeutic work.

The factors to be considered are the duration and frequency of the exposure, the distance of the anti-cathode from the surface exposed, the current supplied to the tube, and last, but by no means the least, the character and conditions of the tube itself.

It is within the tube that the measurable electrical energy is transformed into the radiant energy of the Roentgen rays, which is incapable of accurate measurement. The energy or the influence given off from the tube is made up of rays of different physical and physiological properties; and these particular properties are dependent upon the construction of the tube and upon the conditions of the variable factors of the tube at the time the current of electricity is supplied to it.

For a thorough understanding of the tube it is well to review the contruction and the various features about a tube together with their purpose and significance.

The length of a tube is of importance because the farther the external terminals of a tube are apart, the less likely is the current to arc across from one to the other, thereby involving loss of electricity which would otherwise pass through the tube to be transformed into X-rays. This invisible loss of electricity in short tubes may be considerable and render the reading of the milliammeter erroneous so far as it is supposed to measure the electricity transformed. The long tubes, therefore, possess a distinct advantage.

The size of a tube has a decided influence in determining the ease or quickness with which the degree of vacuum changes. The larger the internal capacity of a tube the less influence has a certain amount of absorption or giving off of gas upon the total amount present, or, in other words, the degree of vacuum.

The thickness of the glass opposite the anti-cathode is a very material factor. Glass is very impervious to the

Read by invitation before the 7th Annual meeting of the American Roentgen Ray Society at Niagara Falls, N. Y., August 29 to 31, 1907.

rays and a slight increase in thickness seriously affects the therapeutic efficiency of a tube. When we see a few layers of gauze filter out physiological rays we can realize how much influence even a thin layer of glass can have. The lack of efficiency of some tubes, under apparently the same conditions otherwise, may doubtless be explained by the thickness or quality of the glass opposite the anti-cathode.

The size of the cathode appears to be immaterial. It has been found that aluminum is the best metal with which to construct the cathode because it gives off particles under the electrical discharge less readily than other metals.

The cathode rays are projected in lines perpendicular to the surface of the cathode. The surface of the cathode is made concave and the rays from it would consequently tend to come to a focus at its center of curvature, but the particles composing the rays being similarly charged electrically, are mutually repellant and do not come to a focus until about twice the distance of the center of curvature from the cathode. At this distance is placed the anti-cathode to receive the impact of the cathode rays. By the impact of the material particles composing the cathode stream upon an impenetrable substance is set into activity a series of ether waves known as the X-rays. The anti-cathode is made of platinum because of its density, impenetrability and its high fusing point. The heavier the anti-cathode the heavier the discharge of cathode stream it can stand without the temperature of the metal being raised too high. Since in therapeutic work heavy discharges of the cathode stream are seldom if ever required, it is not necessary to have a very heavy anti-cathode. The anti-cathode should, however, be sufficiently thick to prevent any cathode rays from being lost by penetrating the platinum. The whole efficiency of the cathode stream should be converted into X-rays and given off from the front surface of the anti-cathode.

The cathode and the anti-cathode should be so placed that the line of the cathode stream should be so far from the walls of the tube that it is not interfered with by the strange static influence due to the wall, or by return of the positive particles. This is a possible error that tube makers are not likely to make.

In some tubes the anti-cathode serves as the anode and in others the two are separate. The advantage of these being separate is that in case of reverse discharge there is less disintegration and shooting off of minute particles of

platinum which deposit on the walls and which tend to absorb the gas and so to increase the degree of vacuum. It is, however, better to have the anti-cathode attached to the anode, for it is found that there is in such case greater efficiency to the rays.

The kind of gas within the tube is apparently of no consequence, since they are not atoms or molecules that composed the cathode stream, but sub-atoms or electrons, which are apparently the ultimate subdivisions of matter.

The degree of vacuum or the relative quantity of gas in the tube is the factor of the greatest moment concerning the tube; for that it is which determines the resistance within the tube and this in turn to a great extent determines the penetrative quality of the rays, and at the same time the quantity of electrical energy allowed to pass to be transformed into radiant energy.

In therapeutic work a most important consideration is to estimate the dosage. This can be approximately estimated only when the character of the tube is constant. To maintain a constant vacuum within a tube it is most desirable that a tube used in this class of work should not be subjected to the conditions which are so liable to bring about a change of vacuum, such as the heavy discharges commonly used in radiographic work. The heavy discharges raise very greatly the temperature of the metal of the anti-cathode and also the glass of the tube. This alters the absorption and elimination of the gas contained in metal and glass. The heavy discharges also increase the shooting off of the particles which deposit on the surface of the glass and absorb the gas, thus permanently raising the vacuum.

The regulating devices are, of course, exceedingly useful in maintaining the proper vacuum. They cannot and should not alone be depended upon in the effort to maintain a constant vacuum. This should be done rather by avoiding in therapeutic work heavy currents. My own best therapeutic results have been obtained by using a current of from one-half to one and a half milliamperes, and the resistance in the tube estimated by an equivalent spark gap of from two and a half to six inches. With such a current a tube will maintain a fairly constant vacuum for a comparatively long time and need very little regulating. Should an exposure of more than ten minutes be needed it is well to let the tube have an interval of a few minutes' rest.

It is best to have tubes of different degrees of vacuum than to attempt to regulate the same tube to suit different cases.

As to the physiological actions and the therapeutic uses of tubes of different degrees of penetration, I am in thorough accord with Dr. R. H. Boggs in his article on "The Adjustment of X-Radiations for Various Physiological Effects," published in the St. Louis Medical Review, November 11th, 1905, in which he describes the five degrees of penetration, with their therapeutic indications.

In conclusion: For therapeutic work it is exceedingly desirable to measure the dosage; to do this we must have as constant as possible the factors that are not measurable and to have variable only the factors that are measable. The duration, distance and electrical energy supplied to the tube are measurable, and the conditions of the tube are largely not capable of exact measurement, and therefore they should as far as possible be made constant.

One requisite of a tube for therapeutic work is that the total amount of electrical energy supplied to the tube should be transformed into radiant energy with as little loss as possible. This is accomplished by the following means; first, that the external terminals of the tube should be so far apart that there is a minimum passage of electricity around the tube instead of into it; second, the glass of the tube opposite the anti-cathede should be exceedingly thin, for even the thinnest glass filters out a material amount of therapeutic efficiency; third, the anti-cathode should be made of such material and thickness as to prevent any penetration of the cathode or X-rays, thereby involving a loss of effective rays. This is an almost inconsiderable factor.

The other requisite of a good therapeutic tube is to maintain a constant vacuum. This is accomplished, first, by having the tube of such size that the absorption or elimination of the gas by or from the metal or glass will not greatly alter the relative amount in the tube or the degree of vacuum; second, the electrical discharge sent through the tube should never be so strong that the temperature of the anti-cathode or the glass walls is raised so high as to alter their absorption or elimination of gas.

The tubes used for therapeutic purposes should not be subjected to the heavy discharges common in radiography. The same tubes should not be used for both kinds of work. It is better to have different tubes for the various classes of therapeutic work than to attempt to adjust the same tube to suit every case.

DISCUSSION OF DR. WILLIAMS' PAPER.

DR. ALFRED L. GRAY, Richmond Va:—I am heartily in accord with what Dr. Williams has said. I have maintained for a considerable time, and Dr. Williams will agree with me, that the static machine is far preferable for therapeutic work, to the coil. It is very necessary that we should maintain an even vacuum and an even degree of penetration so as to get as little variation in the light as possible. It is a well-known fact that we get a steadier stream of current from a static machine than from a coil. We do not have the powerful discharges that cause these rapid changes in the vacuum of the tube, and it is much less dangerous both to the operator and to the patient.

As to the point brought out of the advantage of having different tubes for different cases, I have had a very striking illustration of that fact recently in the treatment of a case of psoriasis. I at first used for a good while a new tube that I had recently purchased without any marked effect at all on the lesions. With another tube I succeeded in getting a pretty fair tan of the skin, but only slight improvement in the condition. These treatments extended over about two months and I was ready to give up in despair. The patient took a rest for three weeks. Then I determined to try a thinner tube with which I had previously gotten good results in this disease, and in the course of three weeks the psoriasis had entirely disappeared.

This also illustrates the fact that the thickness of the glass is of the utmost importance. The tube with which I got my good effect was made of the very thinnest glass. It was the lightest tube that I had. These points should be borne in mind when we make our selection of tubes.

DR. WILLIAM S. NEWCOMET, Philadelphia:—I want to emphasize one point. I had a tube of certain make that I tried to use on a 110 v coil, but I could do absolutely nothing with it. I tried that same tube on an alternating transformer and found that it worked fairly well. The machine and the tube must balance, although that may not be the correct way of expressing it.

In regard to results with the static machine, I think that the X-ray, is the X-ray, no matter how it is generated. The only difference is how you give it, or how you modify it. You can take a lighter tube and work it on a static machine and get better results than you can with the same tube when it is worked with the coil; in other words, it is a question of the X-ray tube being balanced to its generation. I agree with Dr. Williams in everything he said in his paper.

DR. MIHRAN K. KASSABIAN, Philadelphia:—I agree with Dr. Newcomet that the X-rays are the X-rays no matter how they are generated, but they differ in their quality and quantity. It has been proved that with an increase in the size of the cathodes we get more rays. It has also been proved that by making a tube with two

cathodes, opposite to each other, the one being twice as large as the other, a plate exposed to the larger of the two cathodes is made in half the time as is the plate exposed to the smaller. Therefore, the form, size and shape of the cathode has much to do with the production of the X-rays.

ABSTRACT.

RULE AS TO NEGLIGENCE IN X-RAY TREATMENT.

HENRY WINTHROP HARDON, A. M., LL.B.

Medical Record, March 16, 1907.

In February of this year a case was brought to trial before Judge Brady and a jury in the Supreme Court of New York in which a well-known physician was charged with negligence in that he "unskillfully, carelessly, and negligently administered to the plaintiff what is commonly called or known as X-ray treatment. The case was left to the jury, who found a verdict for the defendant.

The Facts—The plaintiff, about thirty-five years of age, had had an operation for tuberculous glands on the right side of her neck. A large scar, with considerable loss of tissue, marked this operation. Subsequently, the glands on the left side of her neck were similarly affected, and she applied at a hospital for treatment, but refused an operation. She was then advised that X-ray treatment for this malady was often successful, and in the spring of 1903 she applied to a physician for that treatment. After several applications, he noticed on one occasion when she visited his office that she had developed a slight dermatitis. He then suspended treatment for about two weeks. Shortly after, and while still under treatment by this physician, she applied to the defendant for X-ray treatment, and during May, 1903, the two physicians treated her contemporaneously, each remaining in ignorance of the other's treatment.

In the fall of 1903 she had three treatments from the defendant at intervals of about ten days. A 16-plate Waite & Barlett machine was used with a 5-inch General Electric tube. The surface of the tube was not less than 8 inches from the plaintiff's neck, and the exposure on each occasion lasted 8 minutes. Her head and shoulder were protected by sheets of lead foil, with an aggregate thickness of about 1-12-inch. Four or five days after the third treatment a dermatitis of the second degree began to develop, extending from the bottom of the neck to above the ear, and embracing the whole left cheek. She called on the defendant, who prescribed an antiseptic dressing and urged her to call again in a day or two. He saw her only once more, about ten days later, when the wound was purulent and dirty, and the hair about the ear had fallen.

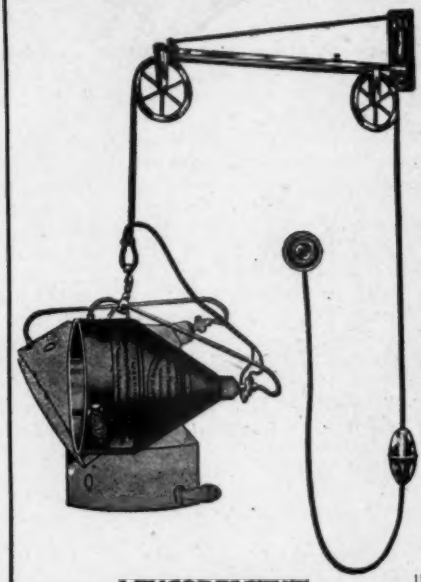
At the time of the trial she had a network of telangiectases over the glands in her neck and extending into her cheek, and a slight sclerosis behind the ear. Her hair had grown again. The glands were still slightly enlarged on both sides of the neck. She had been examined in October, 1904, after suit began, and it appeared that the telangiectases had increased considerably since that time. She had had further X-ray treatment *from a third physician* in the interval.

The Expert Evidence.—The evidence of experts on both sides was that the duration of the treatment and the distance of the tube from the neck was regarded as safe, that the static machine was deemed safer than a coil, that the quantity and quality of the X-ray continually varied, not merely from day to day, but in the course of a single application, that the protection by a lead sheath was the

best known to science, and that *no means was known to science of accurately measuring either the quantity or quality of the X-ray.*

The Law.—On this state of facts, the Judge charged the jury upon the question of the physician's duty according to the familiar rule. (*Pike v. Honsinger*, 155 N. Y. 201). First, he must possess "only that reasonable degree of learning and skill relating to X-ray treatment commonly belonging to a physician and surgeon using that treatment in the city of New York, in November, 1903." Second, he must use "only reasonable care and diligence in the exercise of his skill and the application of his learning in the treatment by X-ray." Third, he was bound to treat the plaintiff "according to his best judgment." The Judge pointed out that the defendant was here charged with negligence or breach of duty only in the actual treatment, the second branch of the duty imposed on him by law, as above defined. The possession of adequate skill and learning, and the exercise of best judgment were thus not in the case. Reasonable care and diligence in the treatment meant "such ordinary care and diligence as is usually given by a physician in good standing. It does not mean the highest possible care and diligence, or such care and diligence as might have been used by some other physician, or even by the defendant himself." The physician is not an insurer or guarantor, and "*in X-ray he does not insure the patient against a burn.*"

The part of the charge of chief significance, however, was that in which the Judge dealt with the doctrine known as *res ipsa loquitur*. Briefly stated, that doctrine means that the accident and the surrounding circumstances speak for themselves, and afford *prima facie* proof of negligence. A common instance of the application of the doctrine is found in a railroad collision between two trains. The Court knows, and everybody knows, that when trains are operated with ordinary and reasonable care they do not collide, and the mere fact of a collision, therefore, affords evidence of negligence; the accident speaks for itself. But the Court here holds that the mere happening of an X-ray burn is not evidence of negligence, and it reached that conclusion doubtless in view of the evidence of the uncertain state of X-ray science. The Judge charged as follows: "If the jury find that the plaintiff received the burn of which she complains in consequence of the treatment by the defendant, they cannot infer that the defendant was negligent merely because the plaintiff afterwards suffered from X-ray burn, for the cause of the burn may be beyond human knowledge, and even expert experience may not be sufficiently uniform to indicate a sure means of preventing it. Owing to the limitations of human knowledge, the exercise of every reasonable care does not always prevent accidents, and this is especially true in dealing with such comparatively little known forces as electricity and X-rays. The jury cannot find the defendant guilty of the negligence alleged in the complaint unless it can find in the proofs some particular act of negligence which caused the burn. To punish the defendant because he cannot explain the cause of the burn is not necessarily to punish him because he has done wrong, but may be to punish him because he does not know something which science cannot find out, or has thus far been unable to find out. That would be manifestly unfair, and the law will not do it."



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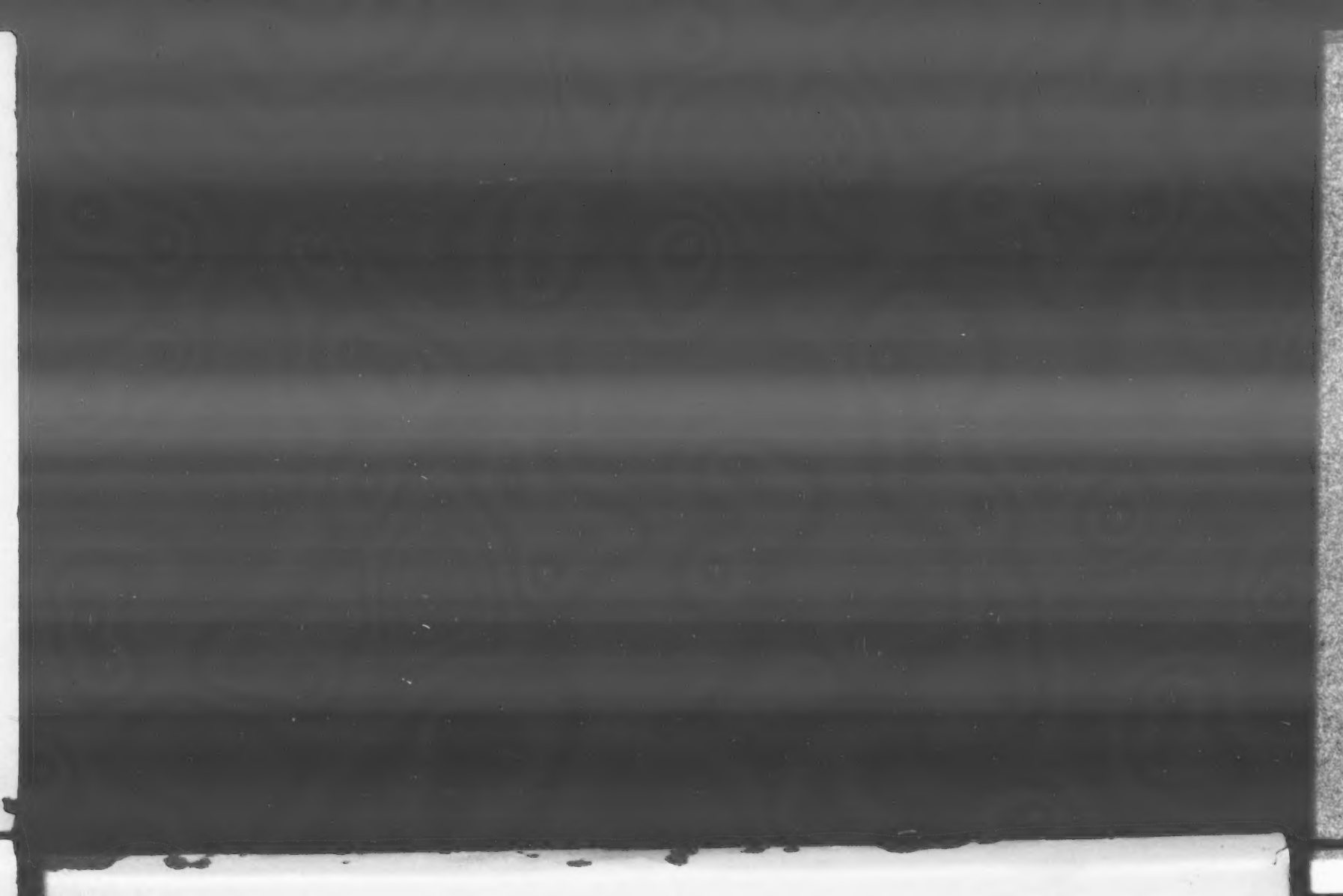

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